TOBACCO.

The NATIONAL ENCYCLOPÆDIA

A DICTIONARY OF UNIVERSAL KNOWLEDGE.

BY

WRITERS OF EMINENCE IN

LITERATURE, SCIENCE, AND ART

VOLUME XIII.

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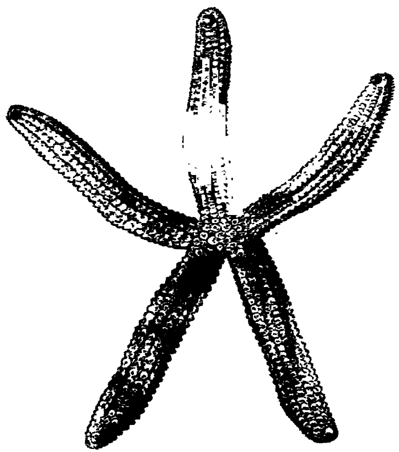
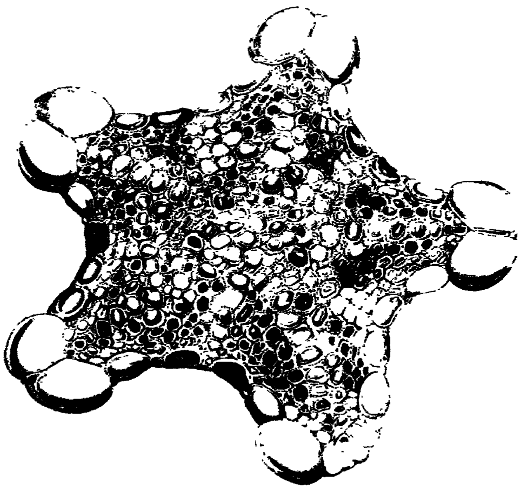
Plate 1.

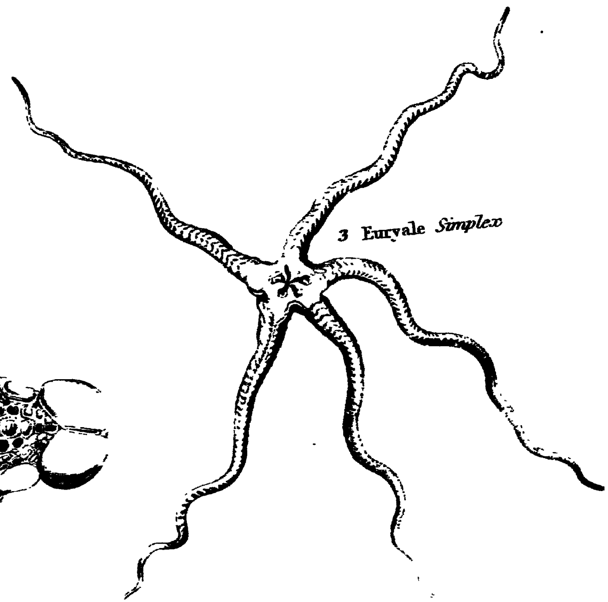
STARFISHES.



1 Asterias *cylindrica*



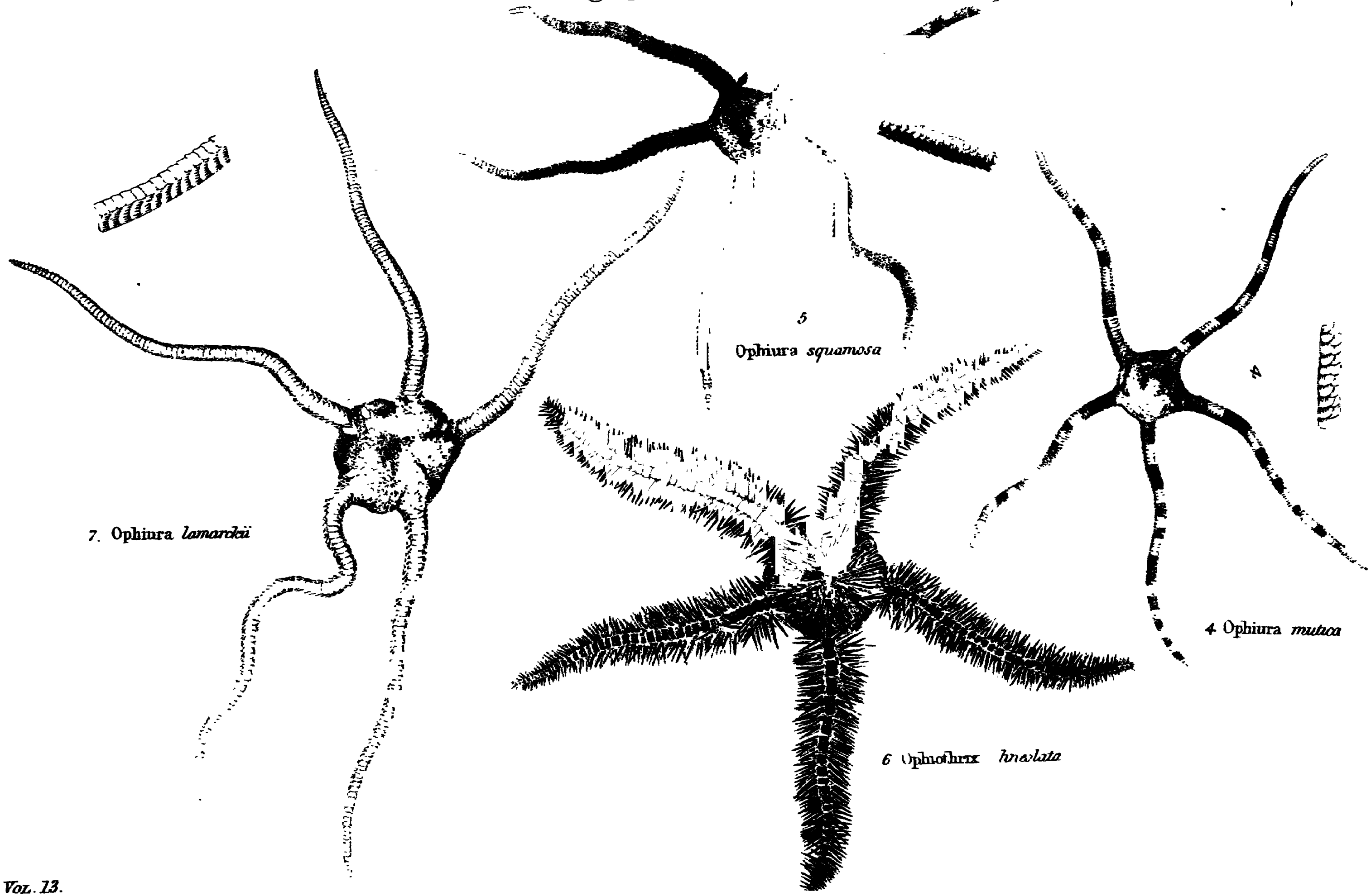
2 Pentagonaster *pulchellus*.



3 Euryale *Simplex*

STARFISHES.

PLATE 2



5 Ophiura *squamosa*

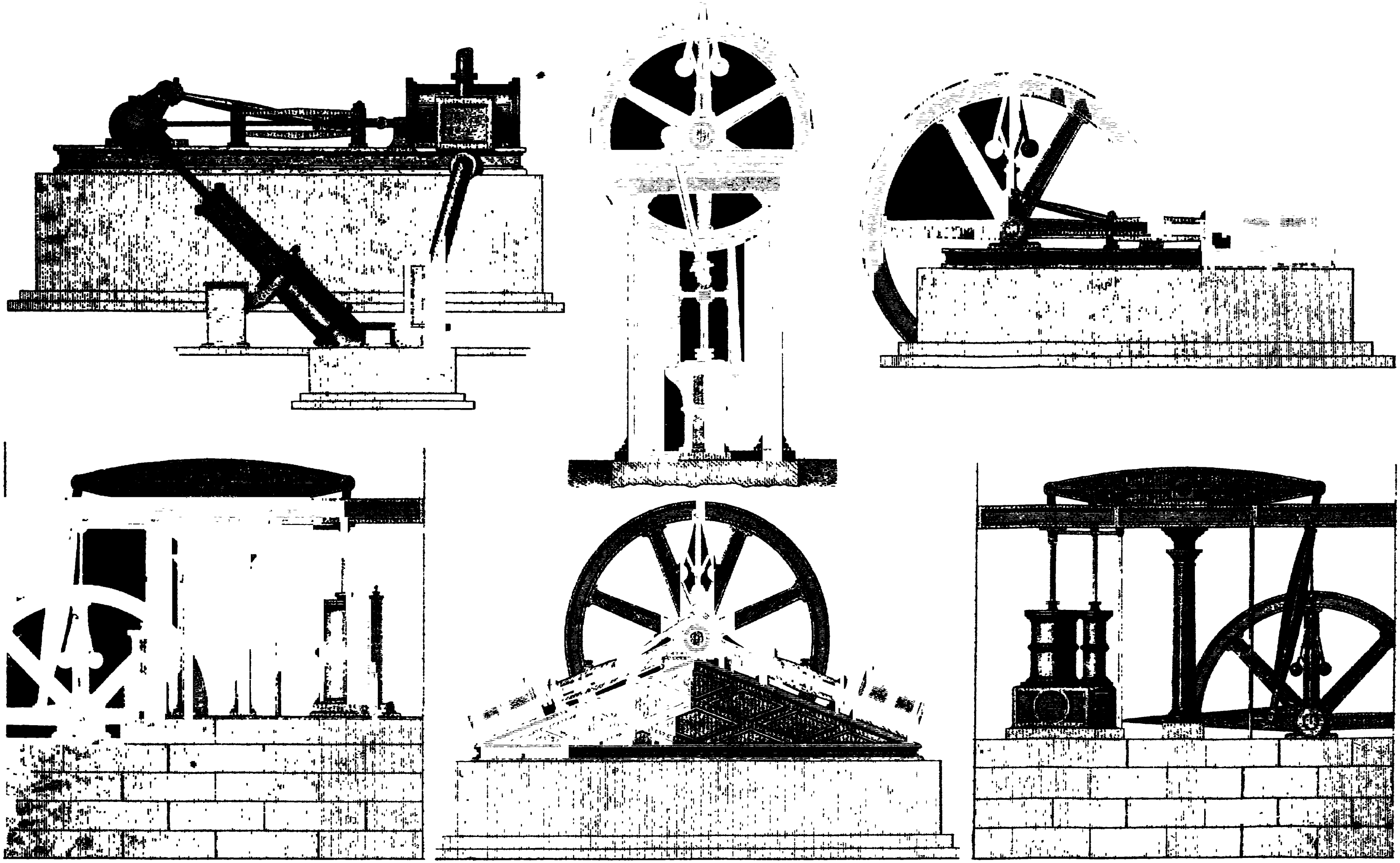
7. Ophiura *lamarckii*

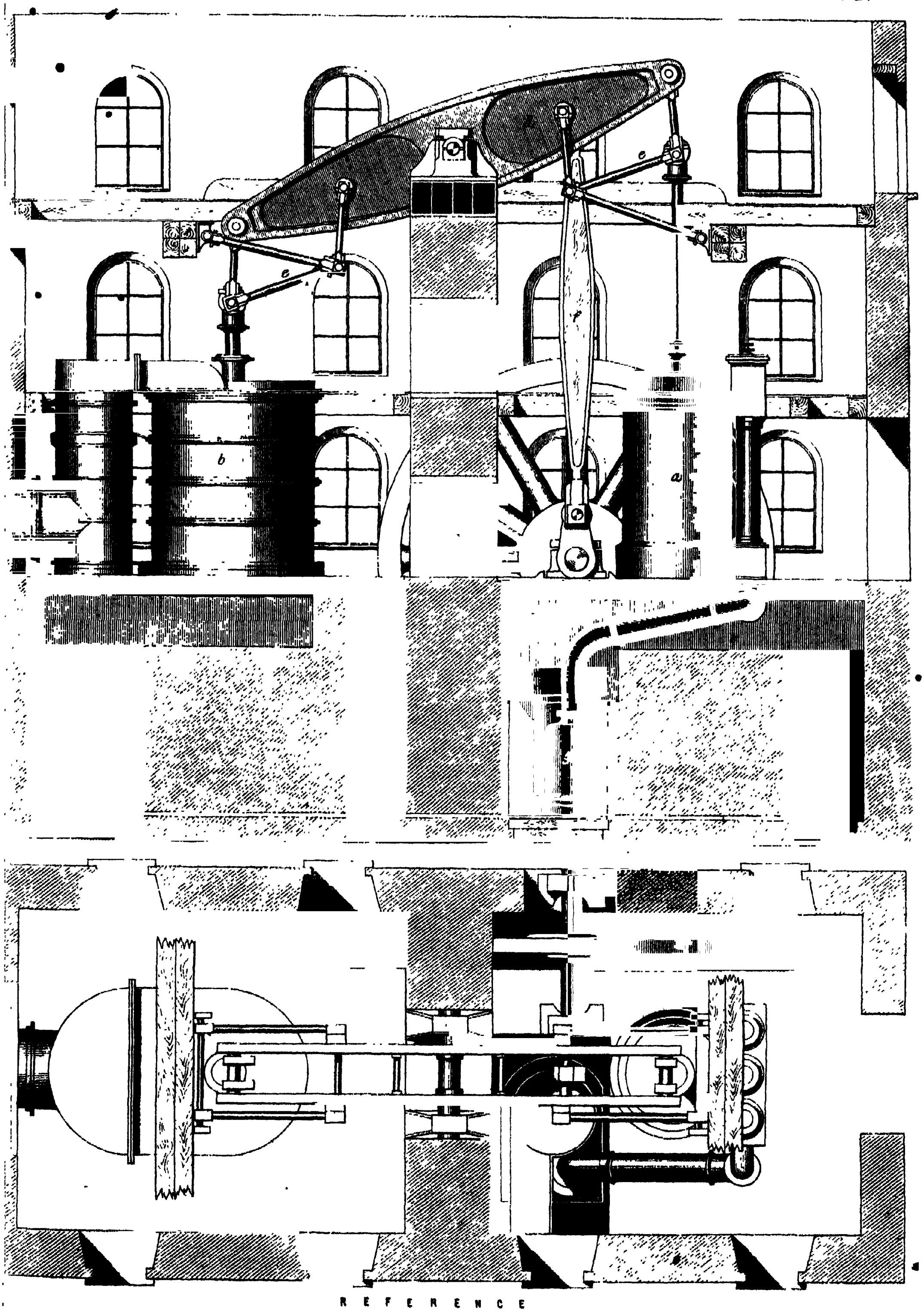
6 Ophiothrix *lineata*

4 Ophiura *mutica*

STEAM ENGINES

TYPES OF STATIONARY STEAM ENGINES





REFERENCE

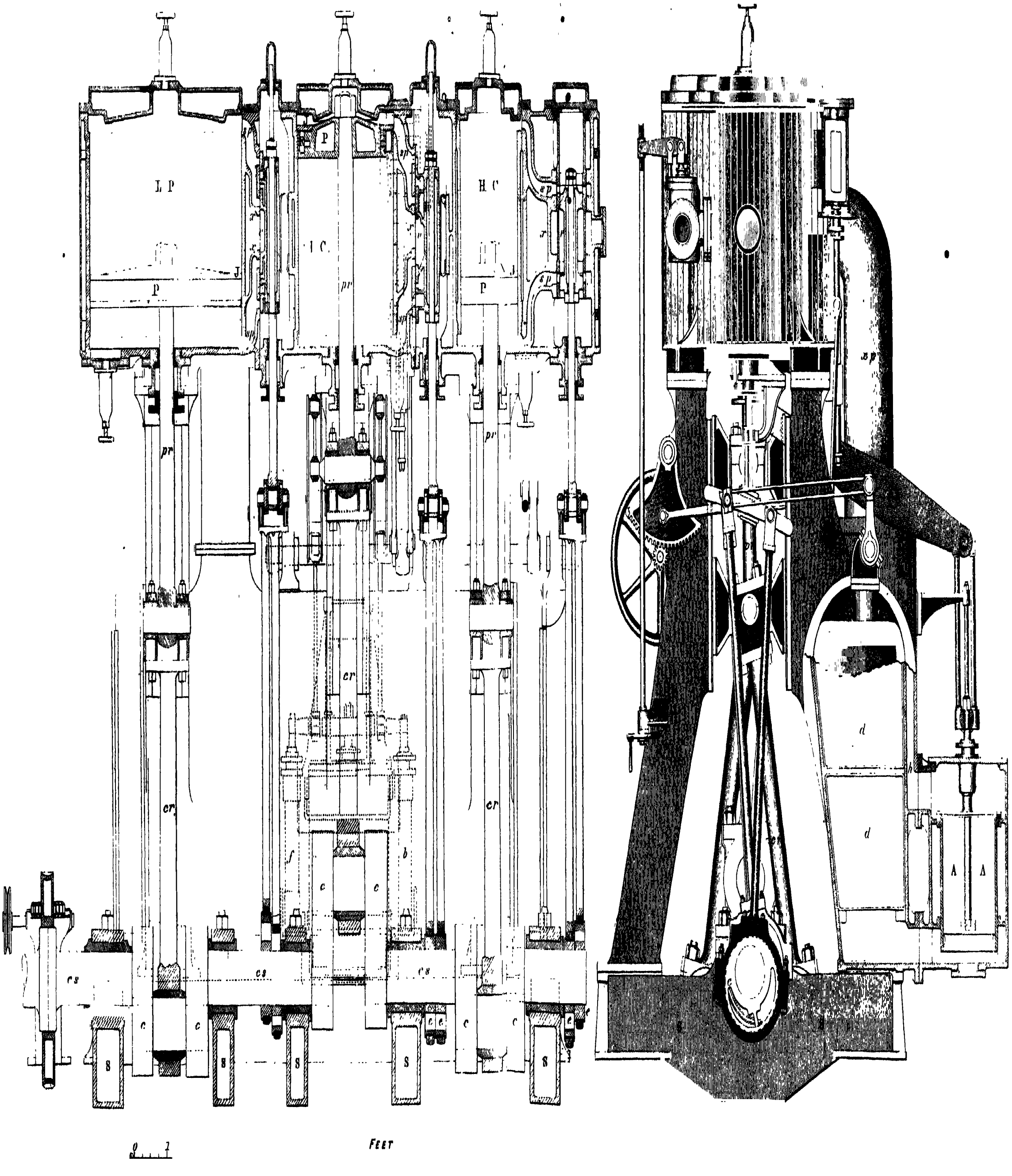
Steam cylinder. b. Blowing cylinder. c. Blast main. d. Engine beam. e Parallel motion. f. Connecting rod.. g. Condenser.

.. 13.

1

STEAM-VESSEL.

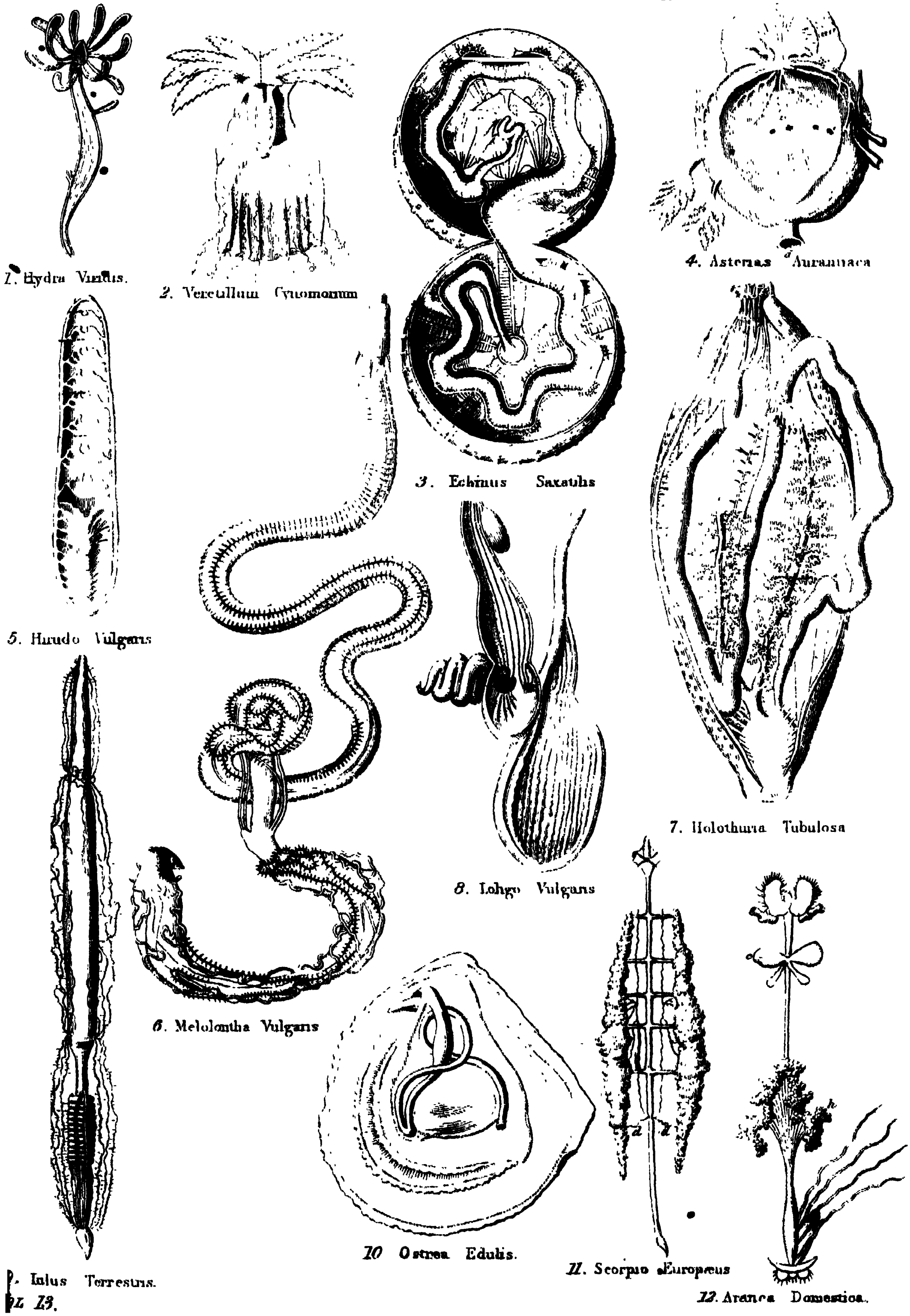
TRIPLE EXPANSIVE MARINE ENGINE.



STEM

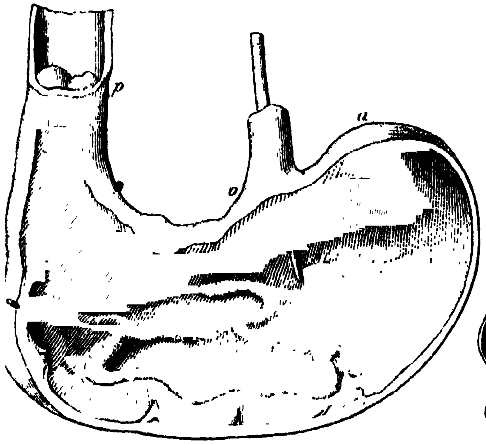
STOMACH.

COMPARATIVE VIEW OF ALIMENTARY CANALS OF DIFFERENT ANIMALS

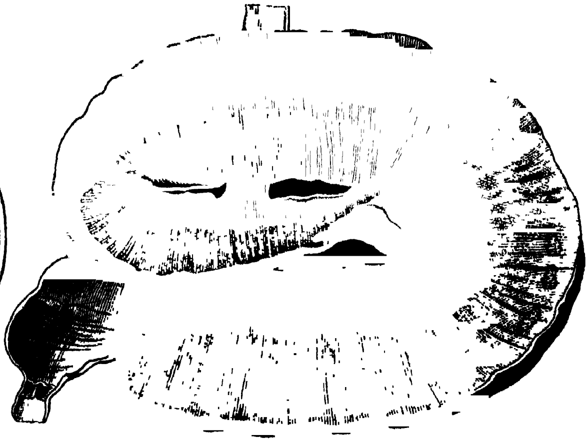


1. Hydra Viridis.
2. Vercullum Cynomorum
3. Echinus Saxatilis
4. Asterias Aurantiaca
5. Hirudo Vulgaris
6. Melolontha Vulgaris
7. Holothuria Tubulosa
8. Loligo Vulgaris
9. Iulus Terrestris.
10 Ostrea Edulis.
11. Scorpio Europæus
12. Aranea Domestica.

COMPARATIVE VIEW OF ALIMENTARY CANALS OF DIFFERENT ANIMALS

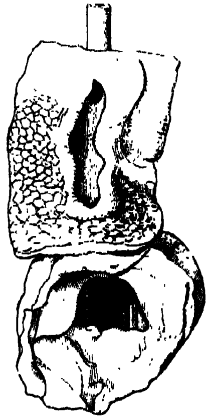


13. Sus Scrofa *Pig.*

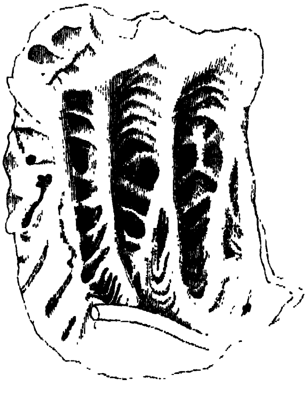


14. Macropus Giganteus *Kangaroo*

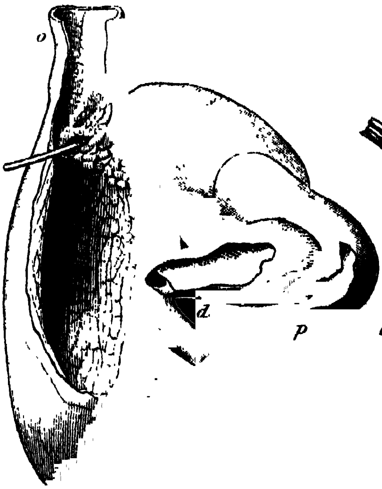
15. Lepus Timidus *Hare.*



16. Bos Taurus *Calf.*

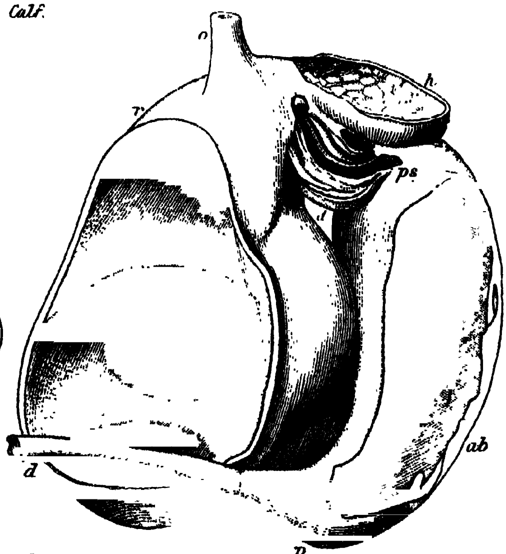


17. Camelus Bactrianus *Camel*



18. Phocœna Vulgaris. *Porpoise.*

19. Pteropus *Vampire Bat*



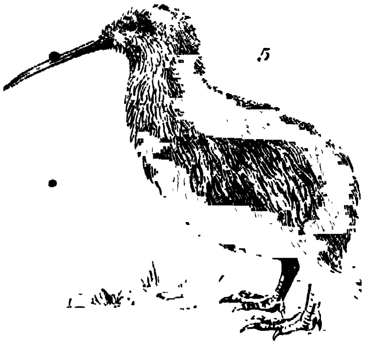
20. Ovis Aries *Sheep.*

Rhea americana *Nandu*

Struthio camelus. *Ostrich*.

STRUTHIONES

5



Aptery x australis.__*Apteryx*.

3

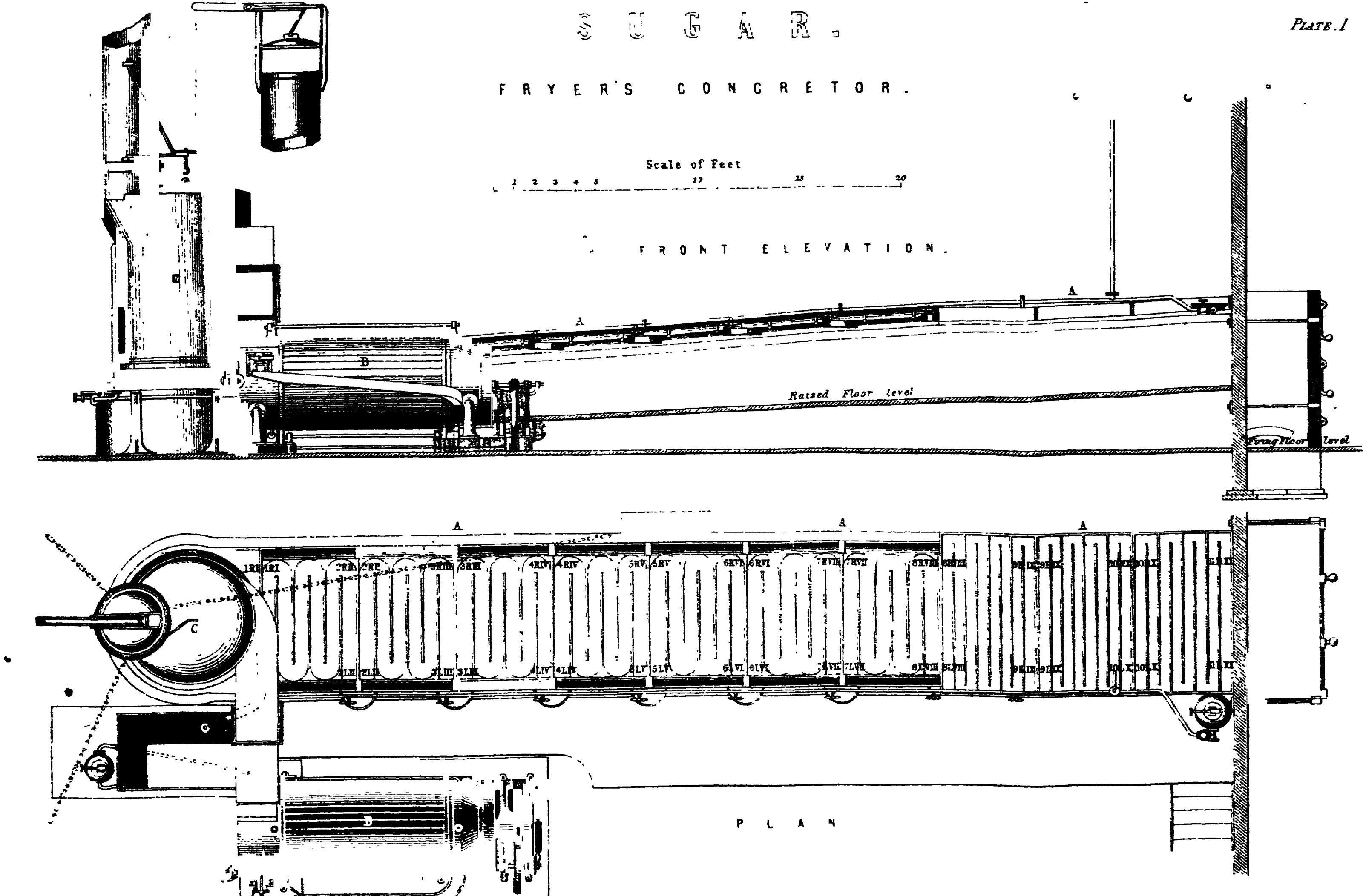
Casuarius galeatus. *Cassowary*.

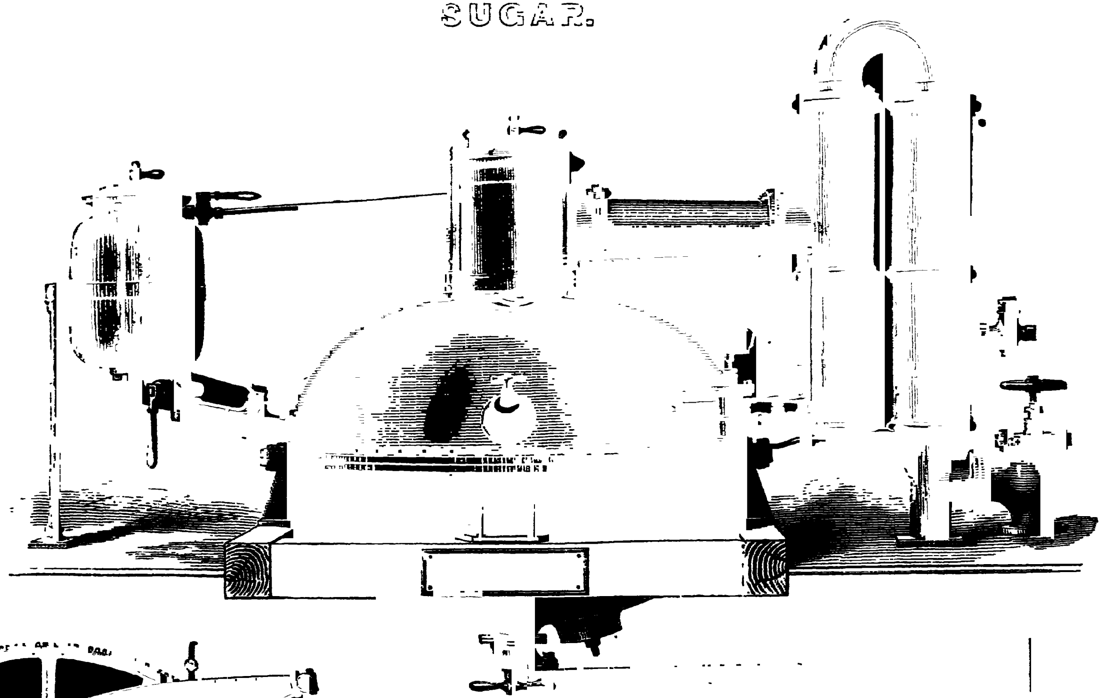
4

Dromæus novæ-hollandiæ. . *Emu*.

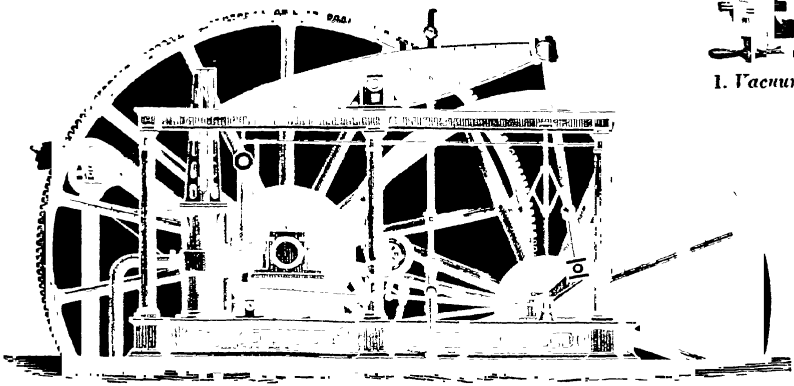
SUGAR.

FRYER'S CONCRETOR.





1. Vacuum Pan.



Side Elevation.

End Elevation.

2, 3. Non-condensing Vertical Engine and Sugar-cane Crushing Mill.

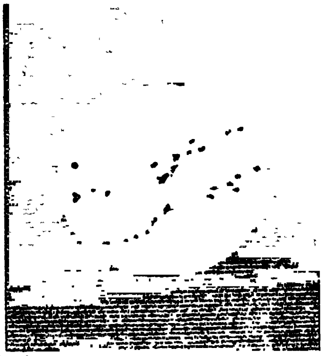


Fig 1 Telescopic view of the Sun. Fig. 2 A Sun spot. Luminous Bridges.

Fig 3. Group of spots.

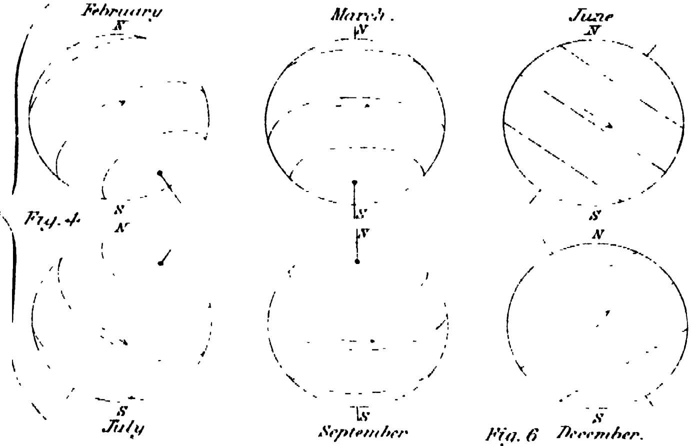


Fig. 4.

Fig. 6

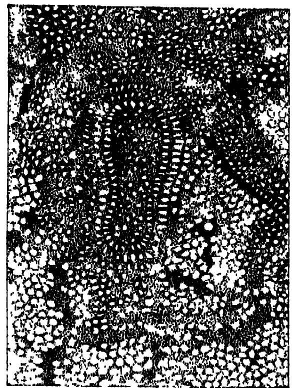


Fig. 5. Pores on surface of Solar Disc

Sun Spot 27 Oct.

Same Spot 29 Oct.

Same Spot 31 Oct.

Same Spot 2 Nov.

Diagram Illustrating the Connection between Auroræ, Terrestrial Magnetism, and Sun Spots

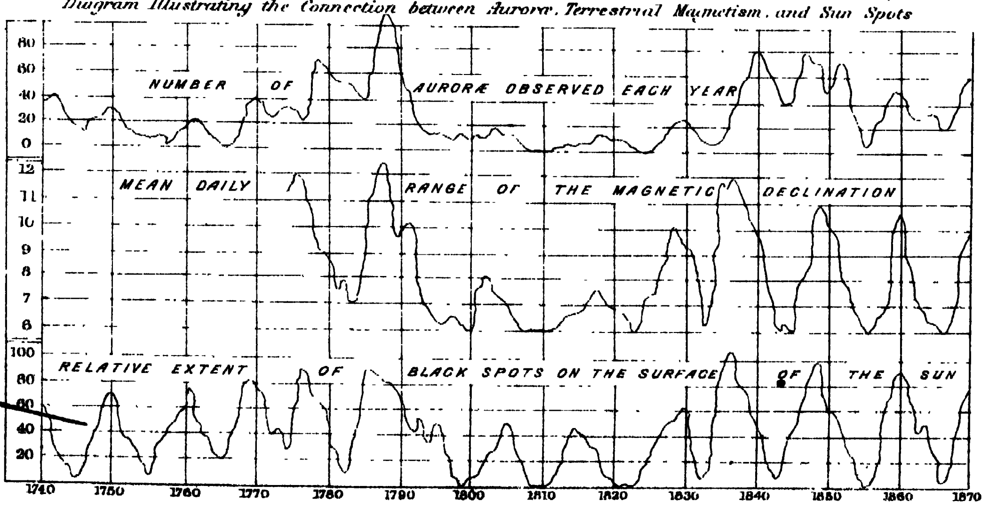


Fig. 7.

S U N.

Plate 2.

SOLAR ECLIPSE — RED FLAMES — CORONA — ZODIACAL LIGHT

[illegible] Sun

[illegible] Solar [illegible]

Fig 3 Solar Prominences Fig 4

Scale [illegible] 00,000 Miles

Fig 5 Solar Prominences

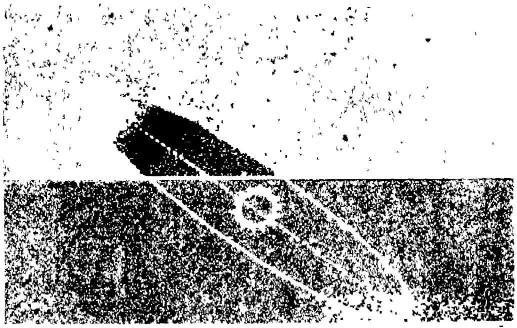


Fig 6 Direction of Axis Zodiacal Light

Fig 7 Measure of Suns distance by transit of Venus

SUN DIAL.

Fig. 1

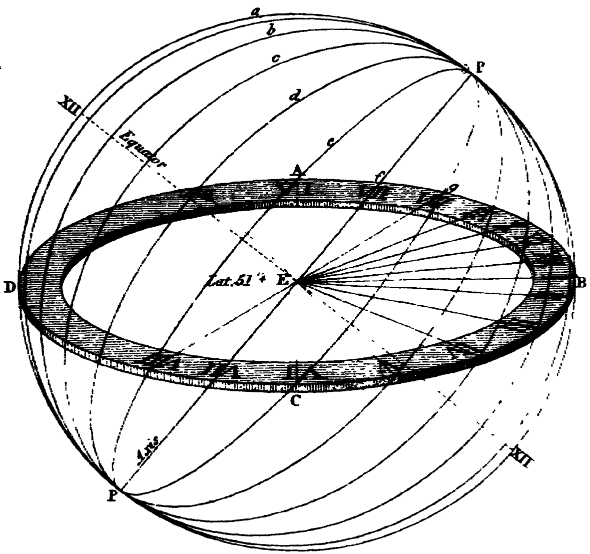


Fig. 2

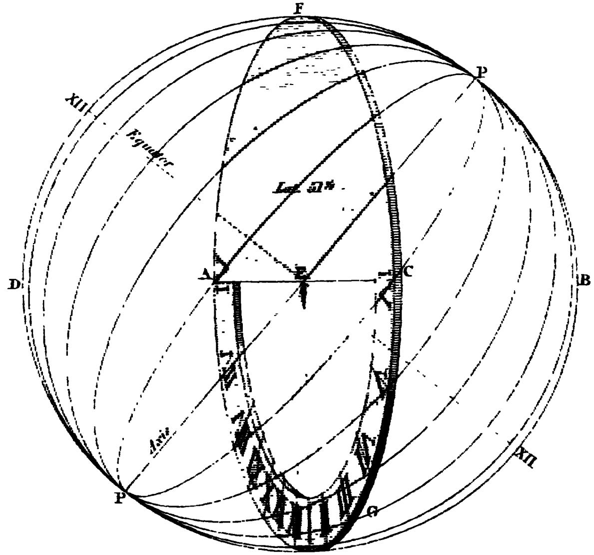


Fig. 3

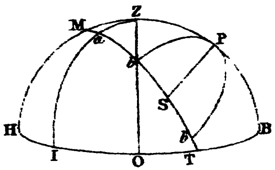


Fig. 4

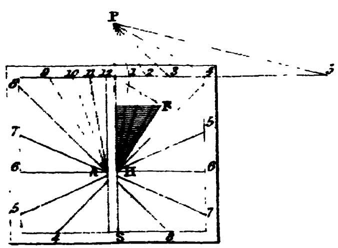


Fig. 5

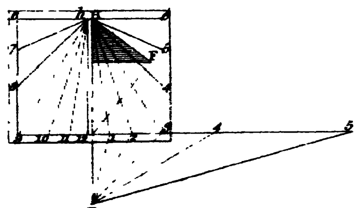
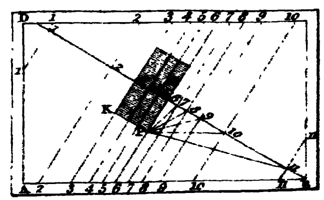
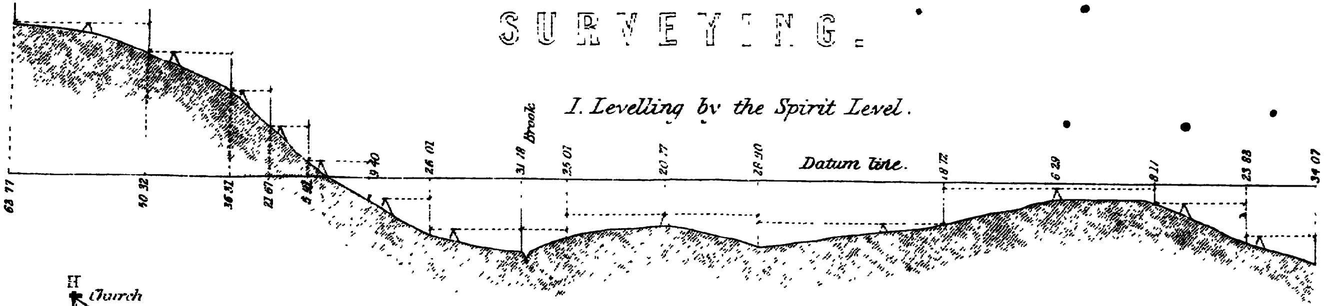


Fig. 6

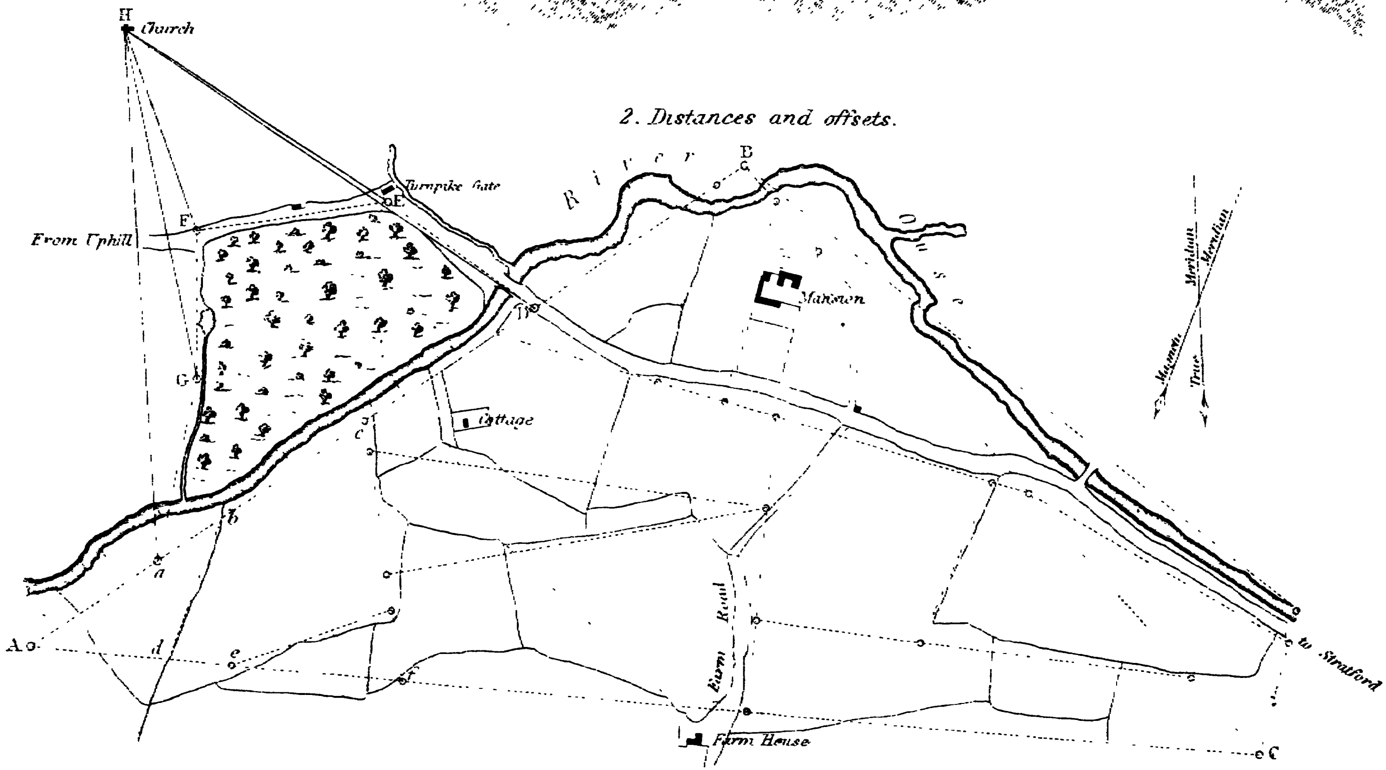


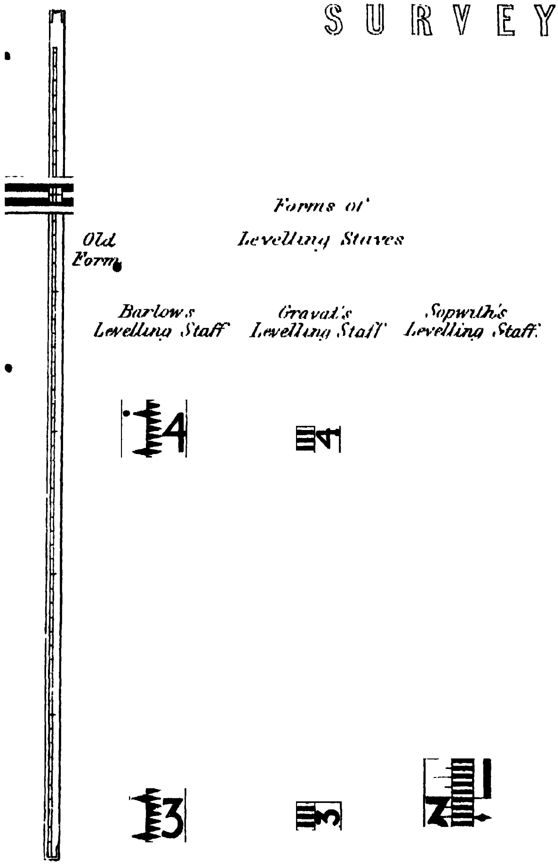
SURVEYING.

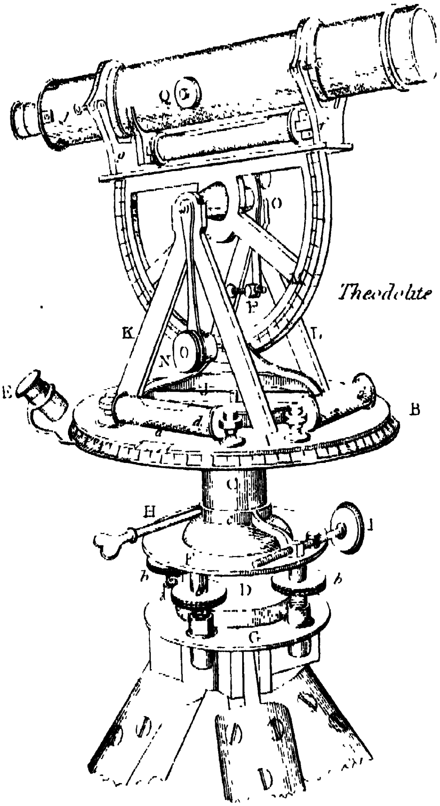
1. Levelling by the Spirit Level.

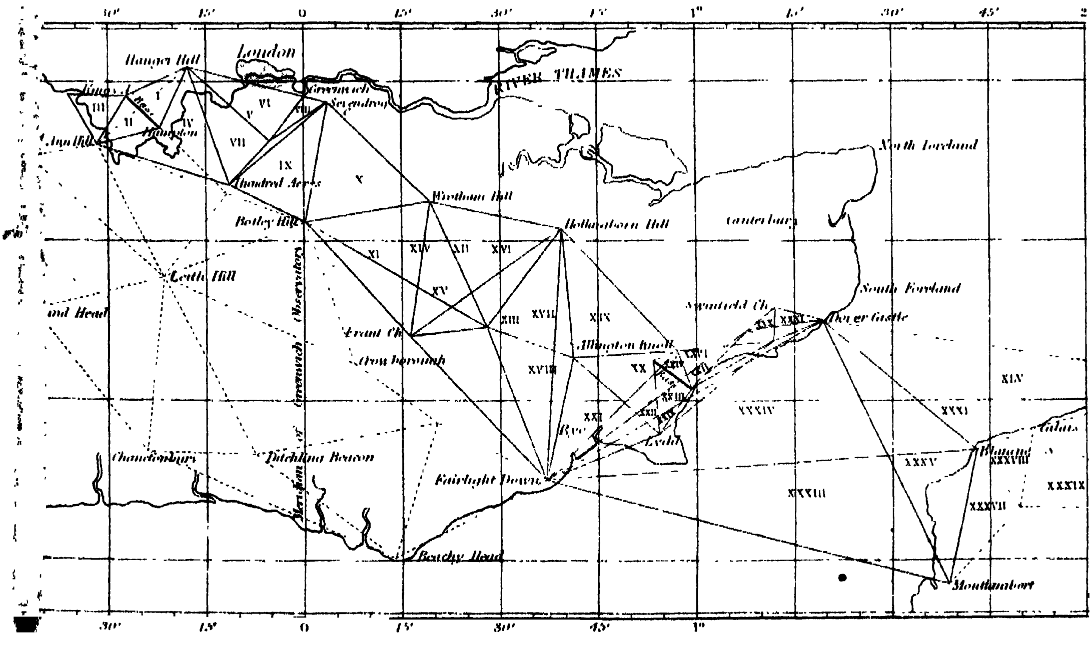


2. Distances and offsets.

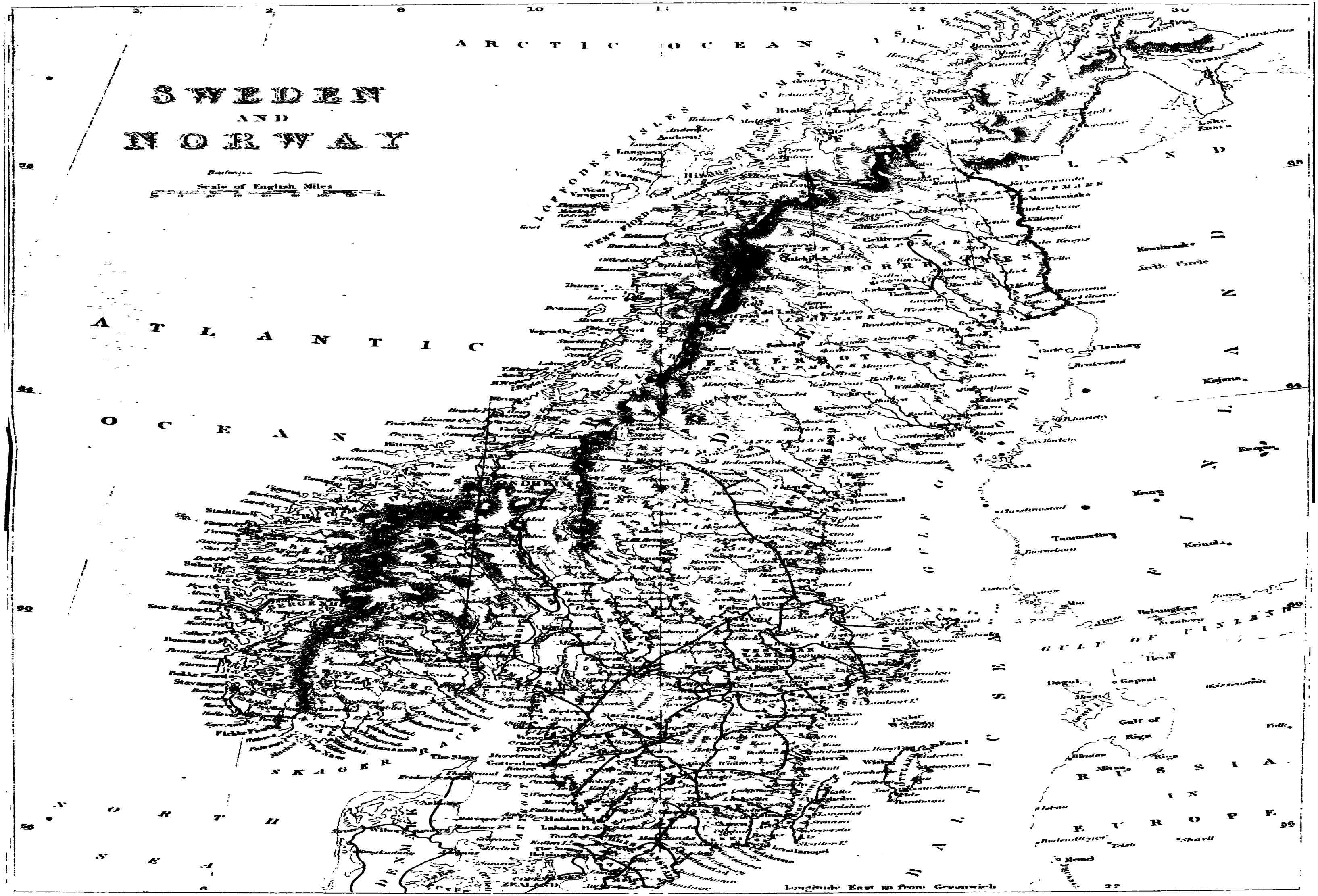


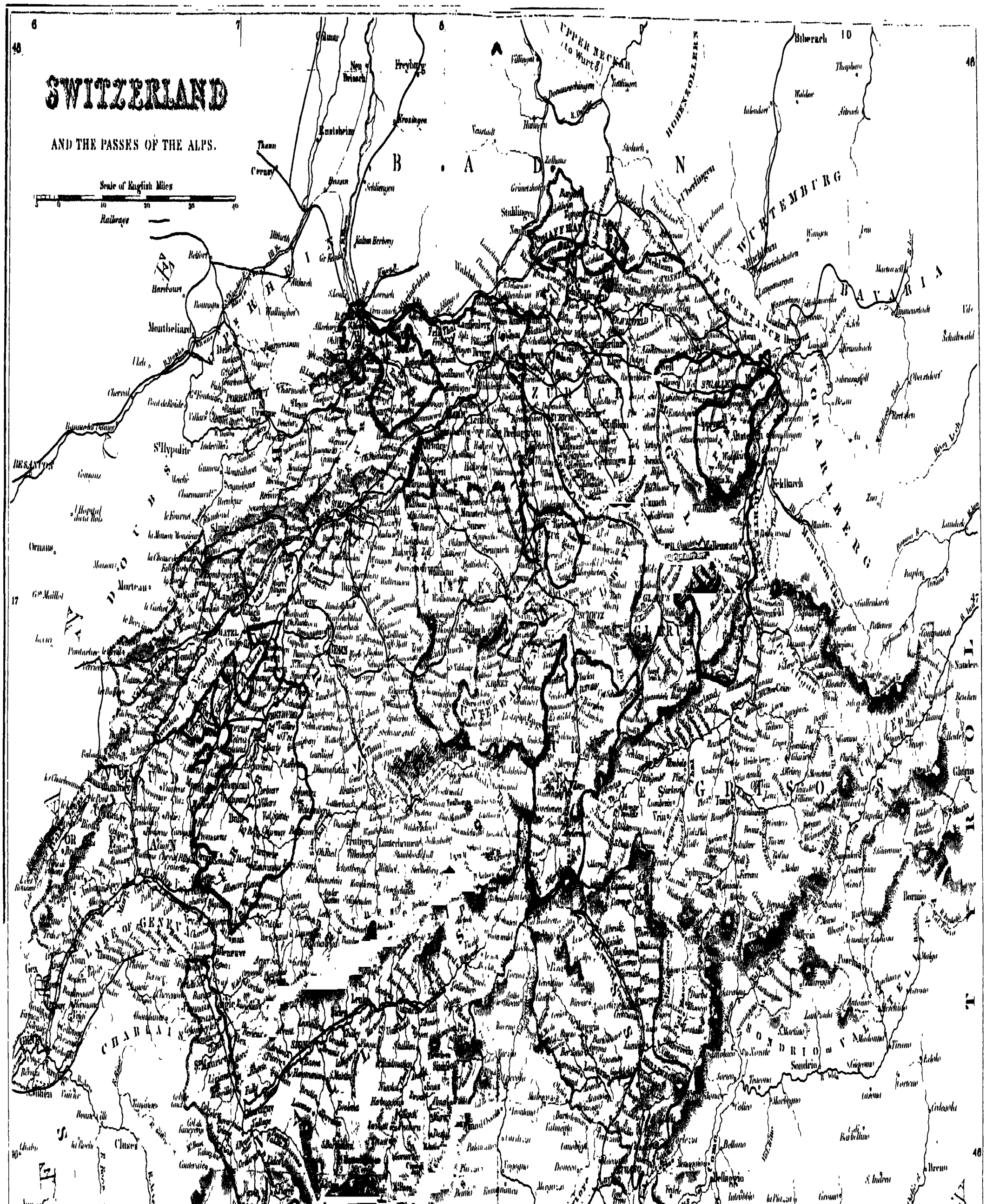






Survey by Triangulation or Trigonometrical Survey.

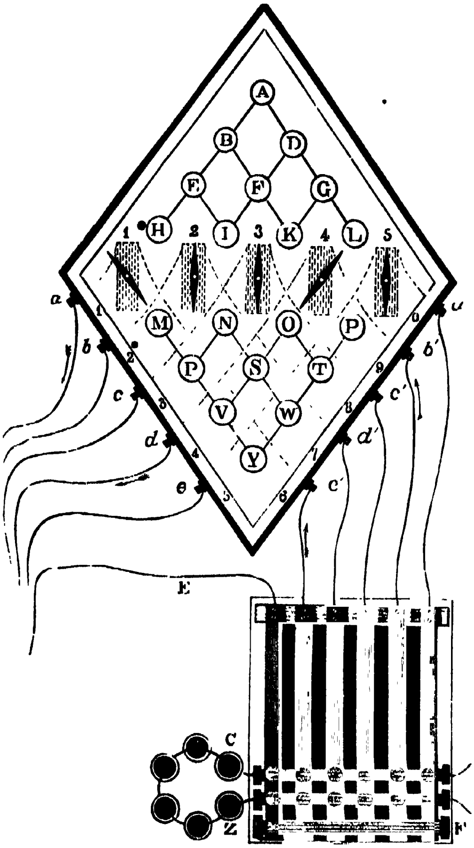

SWEDEN
AND
NORWAY
Railways
Scale of English Miles
ARCTIC OCEAN
ATLANTIC OCEAN
LOFFODEN ISLES
FINLAND
GULF OF BOTHNIA
GULF OF FINLAND
BALTIC SEA
SKAGER RACK
NORTH SEA
RUSSIA IN EUROPE
DENMARK
ZEALAND
Gulf of Riga
Arctic Circle
STOCKHOLM
Christiania
Gottenburg
The Skaw
Longitude East of Greenwich


SWITZERLAND
AND THE PASSES OF THE ALPS.
Scale of English Miles
Railways
East from Greenwich

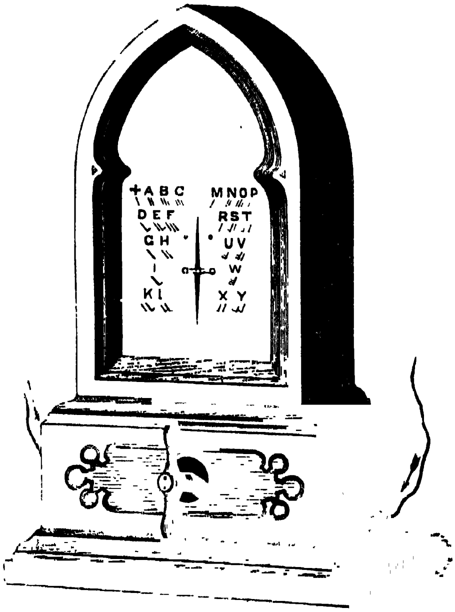
TEA

THEA SINENSIS

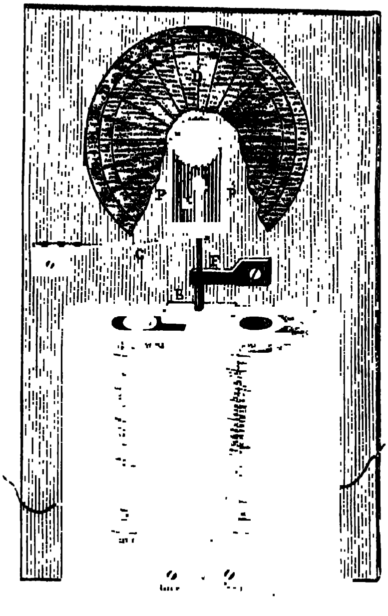
TELEGRAPHY.



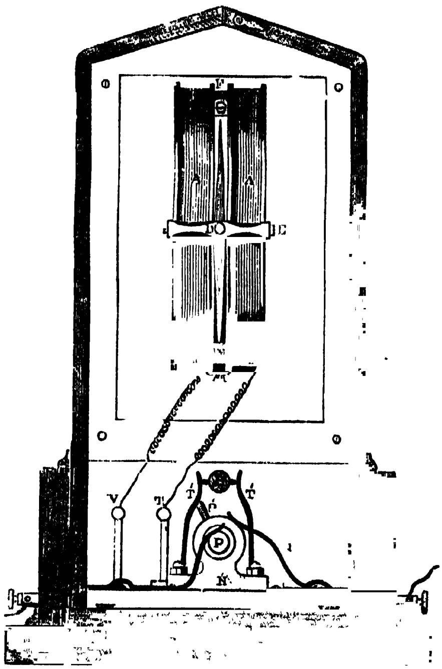
1. *Cooke & Wheatstone's Five Needle Telegraph.*



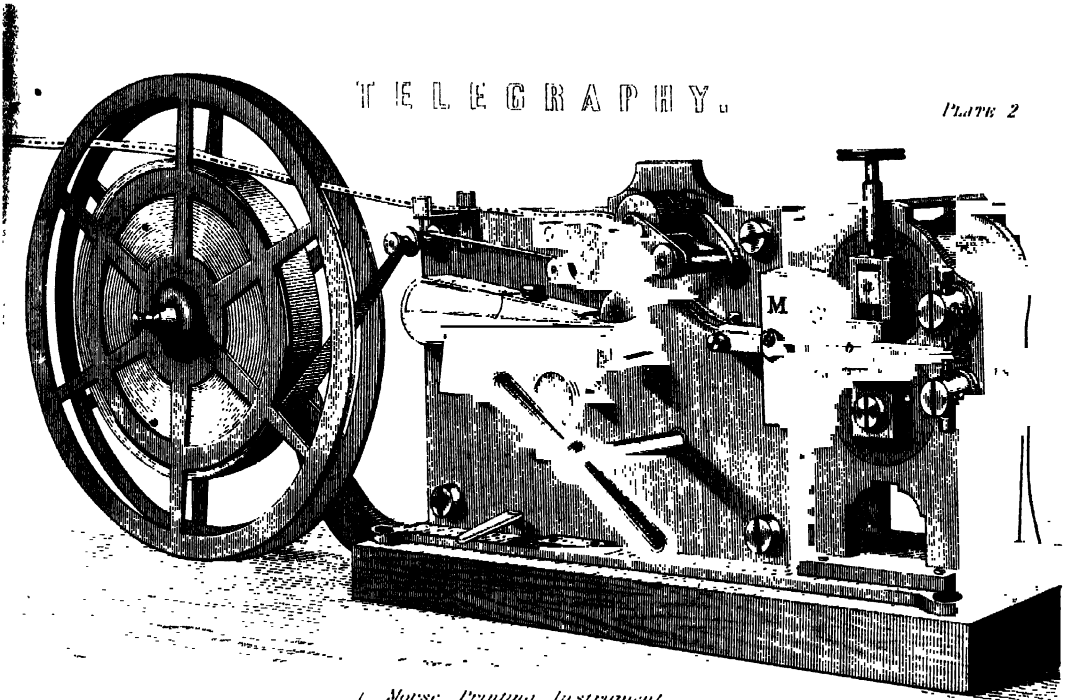
2. *Cooke & Wheatstone's Single Needle Telegraph. Front Elevation.*



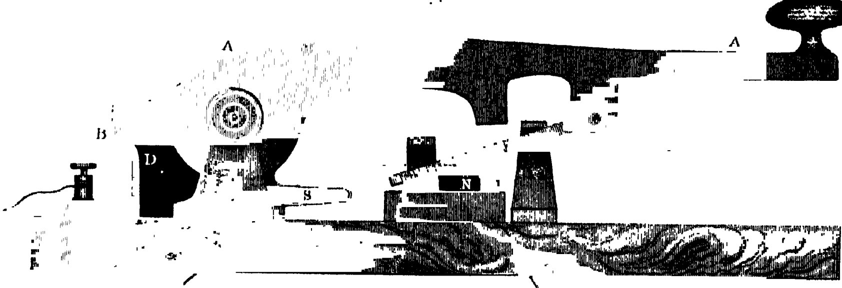
4. *Wheatstone's Original Electro-magnetic A B C Telegraph.*



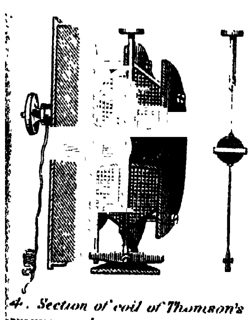
3. *Cooke & Wheatstone's Single Needle Telegraph. Back Elevation, Showing Current Reverser.*



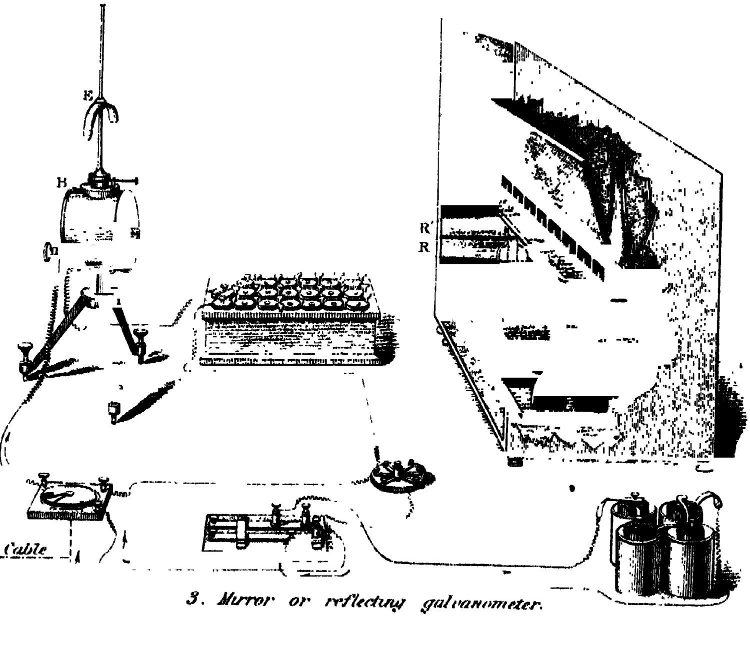
1. Morse Printing Instrument



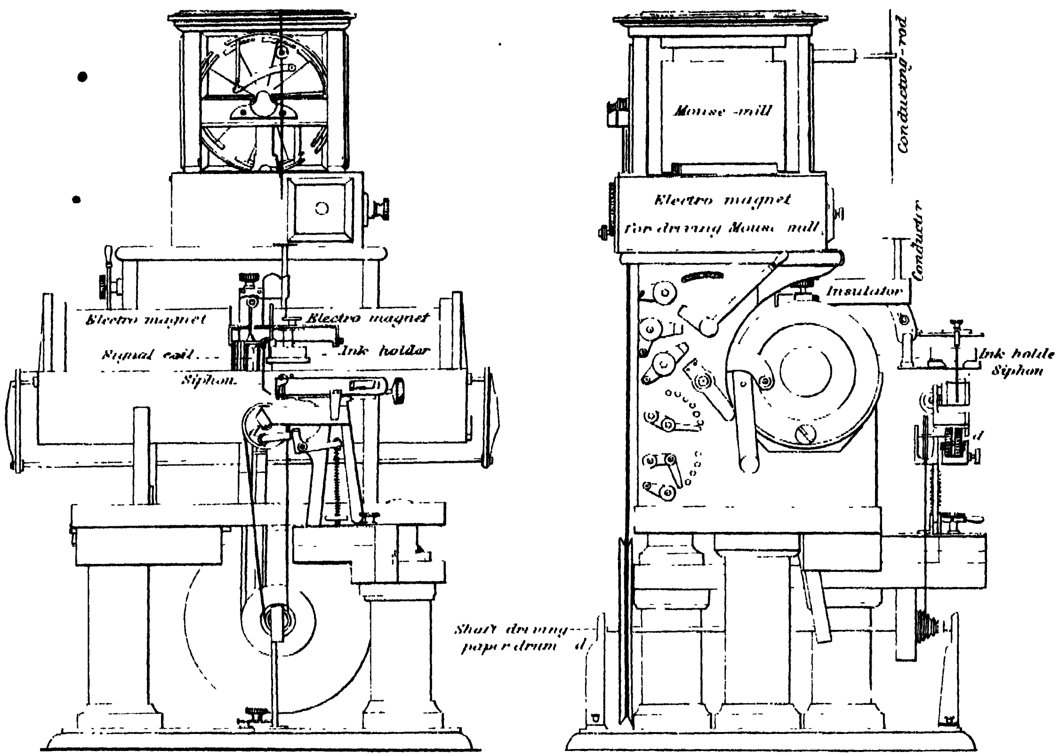
2. Single current Morse transmitting key



4. Section of coil of Thomson's mirror galvanometer, showing the mirror and magnetic needle suspension

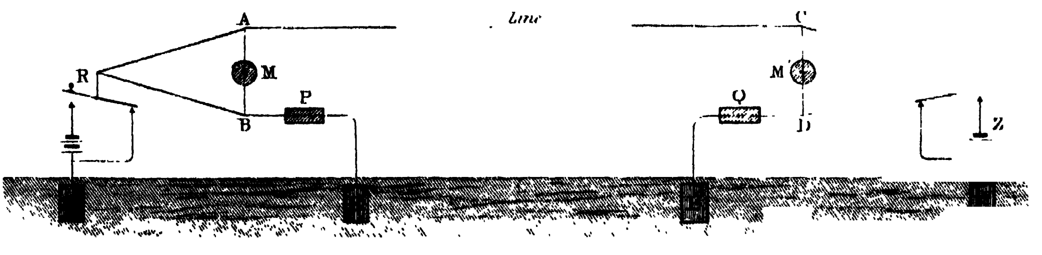


3. Mirror or reflecting galvanometer.

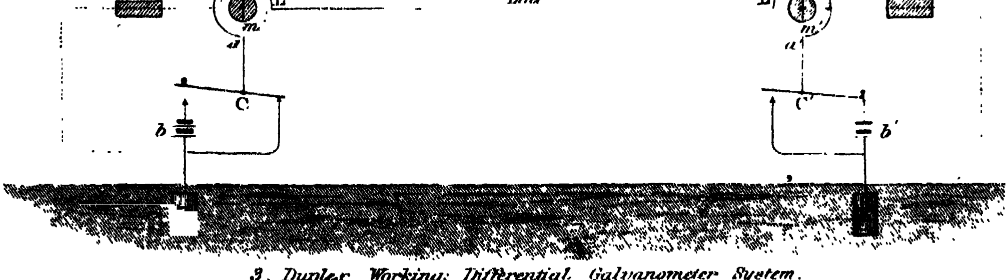


Front Elevation Side Elevation

1. Sir W. Thomson's Siphon recorder



2. Duplex Working on Bridge System

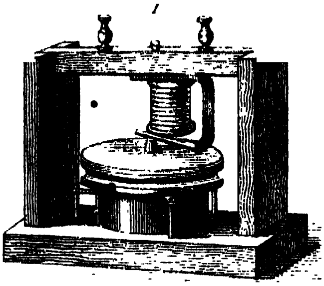


3. Duplex Working; Differential Galvanometer System.

TELEPHONE.

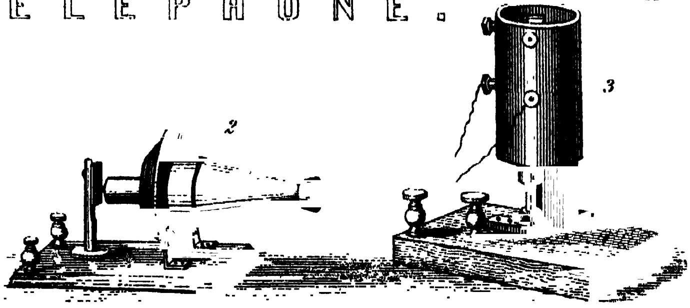
PLATE 1

1



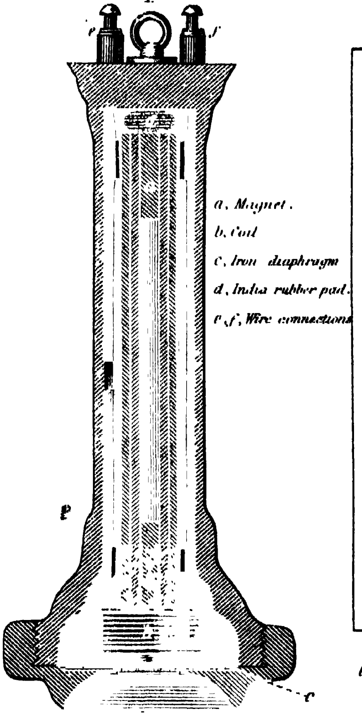
Graham Bell's first telephone.

2 3



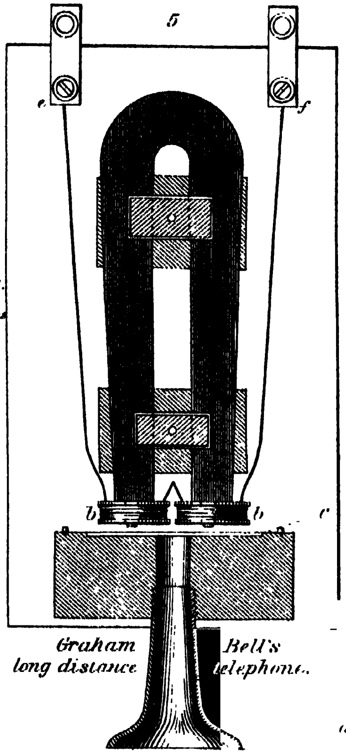
Instruments Exhibited at Philadelphia in 1876.

4



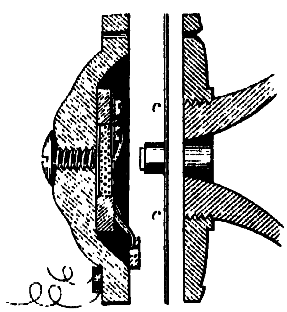
Graham Bell's hand telephone.

5

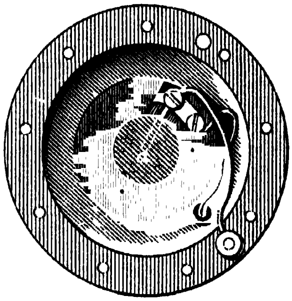


Graham Bell's long distance telephone.

6



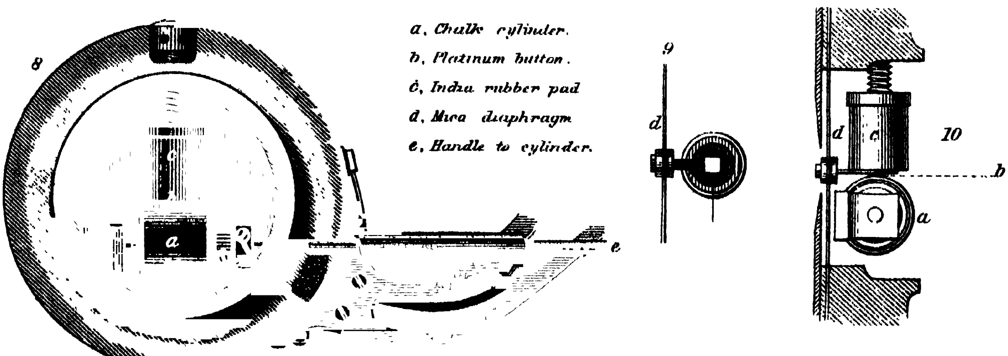
Section of Edison's Transmitter.



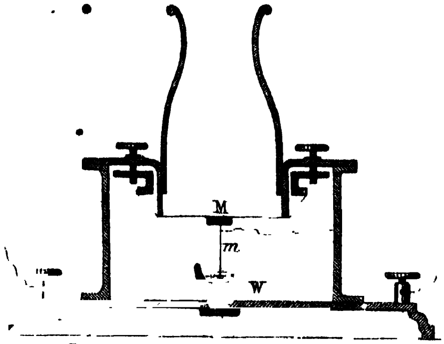
7

Edison's Transmitter.
a. Carbon. b. Vulcanite ring. c. diaphragm.

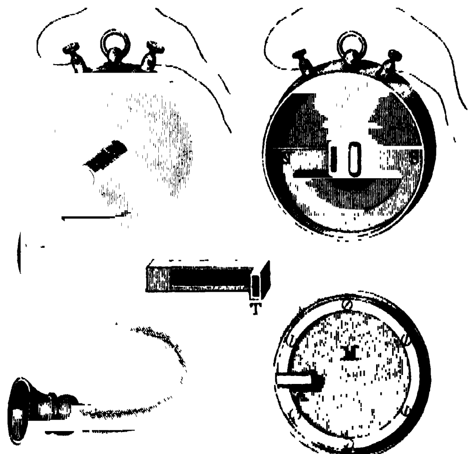
8 9 10



Receiver of Edison's Loud speaking Telephone.

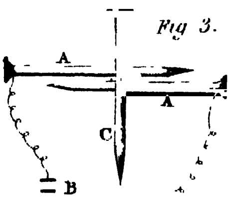


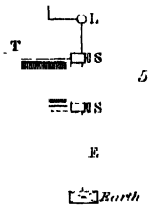
1. *Section of Gray's transmitter*
M. membrane, m. platinum wire, W. vessel of water completing the circuit



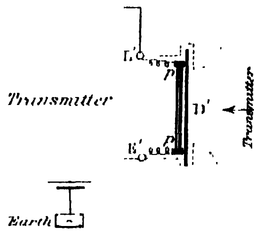
2. *Gower-Bell Telephone*
A. mouthpiece. M. metal diaphragm. N.S magnet. L.T. reed call signal.

Fig 3.

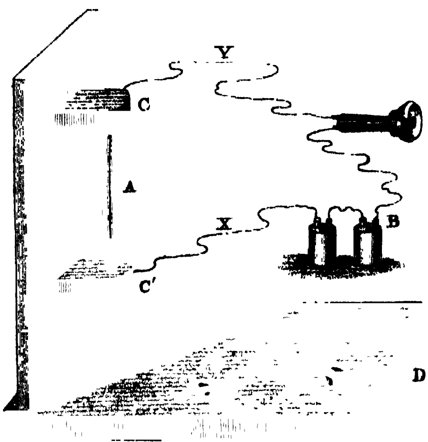




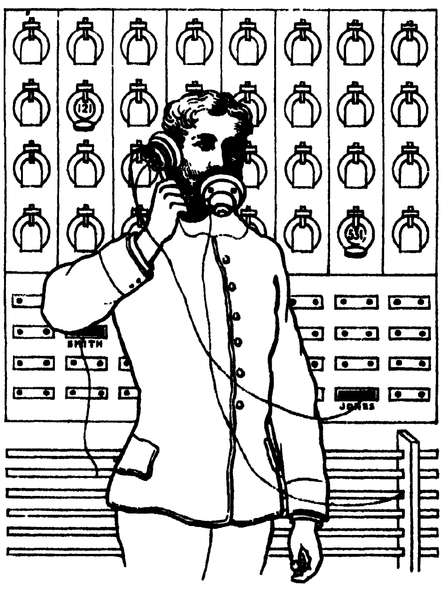
5 *Telephone with Microphone Transmitter*



X. Y



4. *Carbon Microphone.*



6. *Telephone-Exchange Switch board.*

TELESCOPE.

REFRACTING.

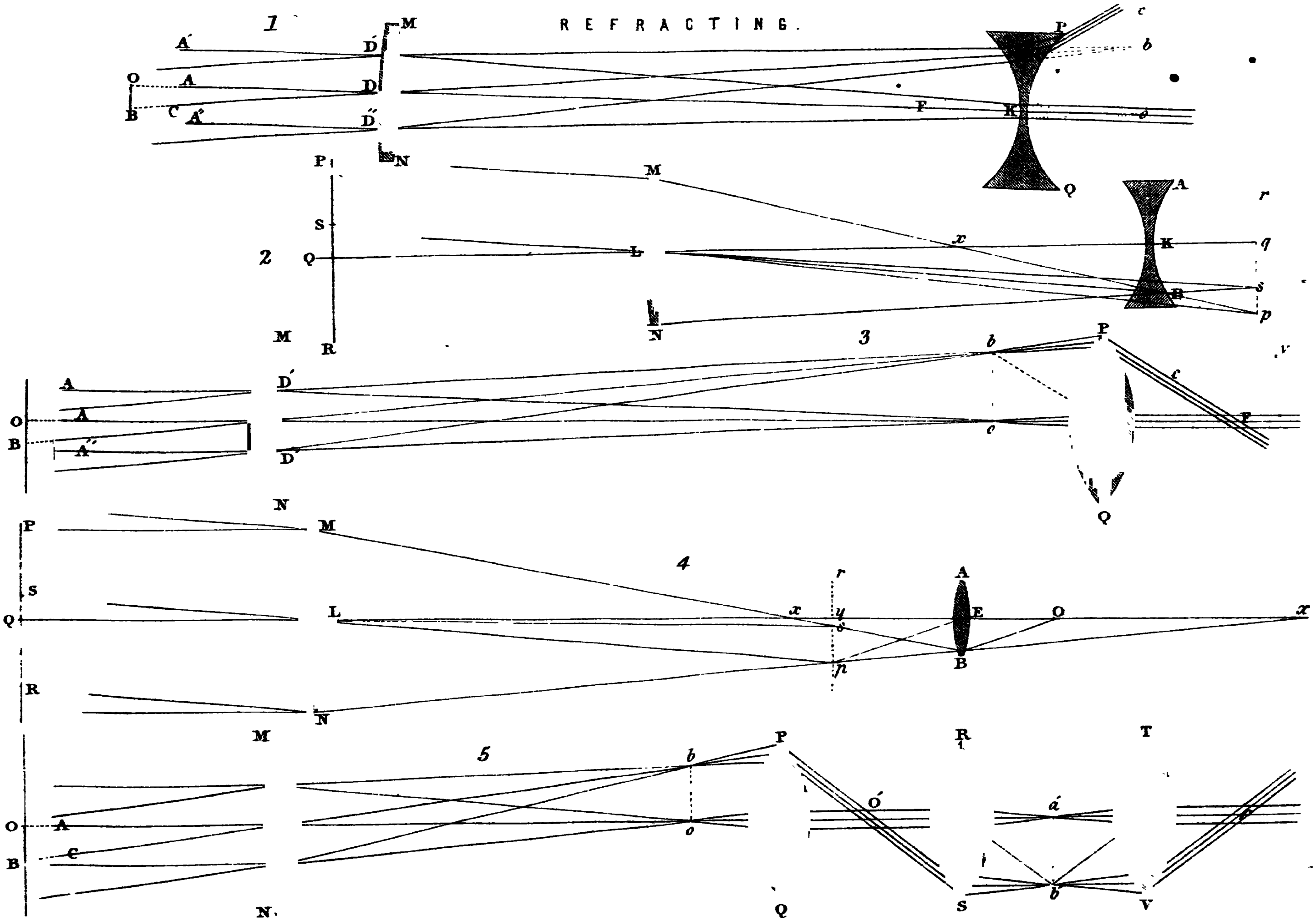
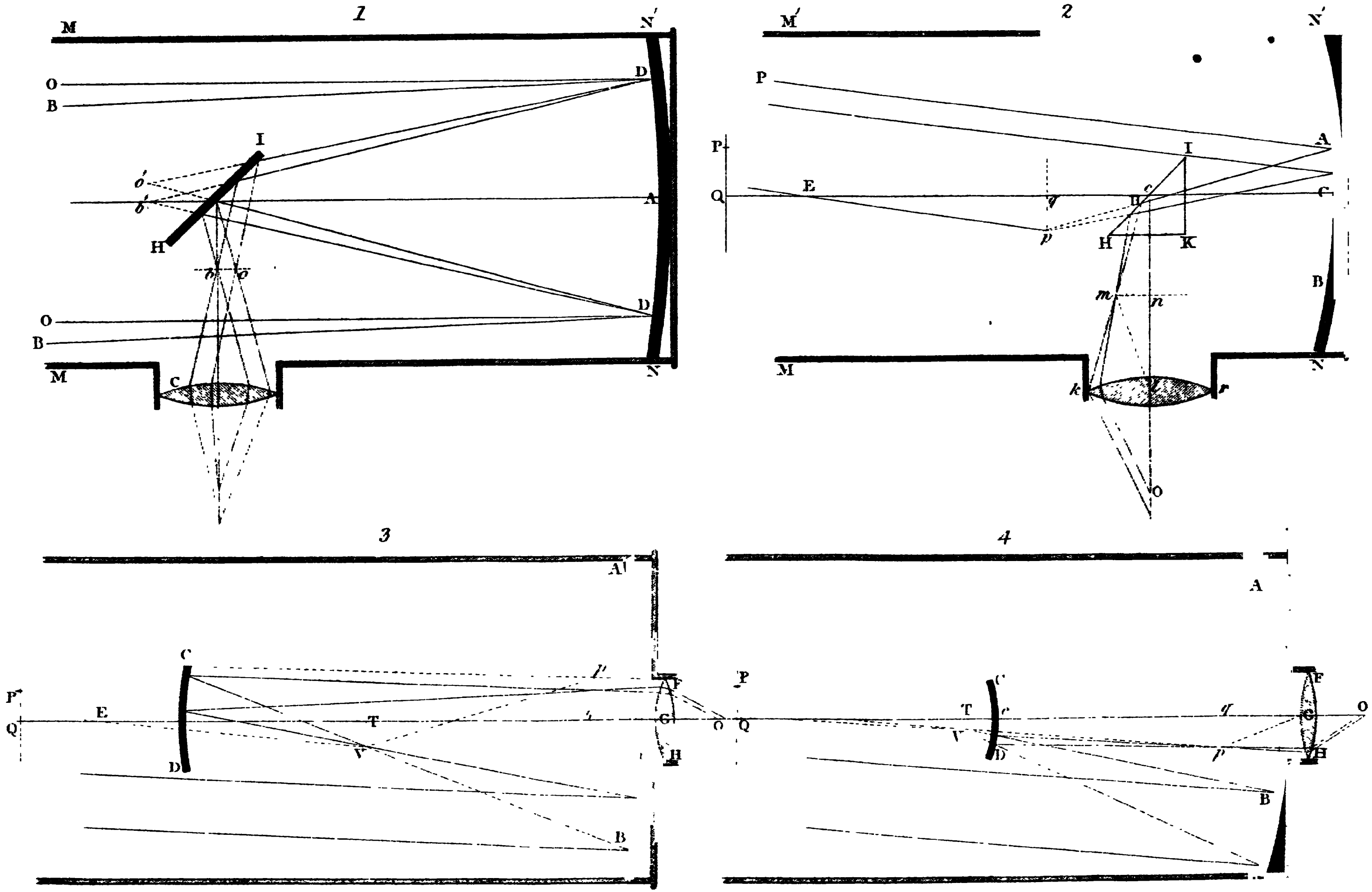


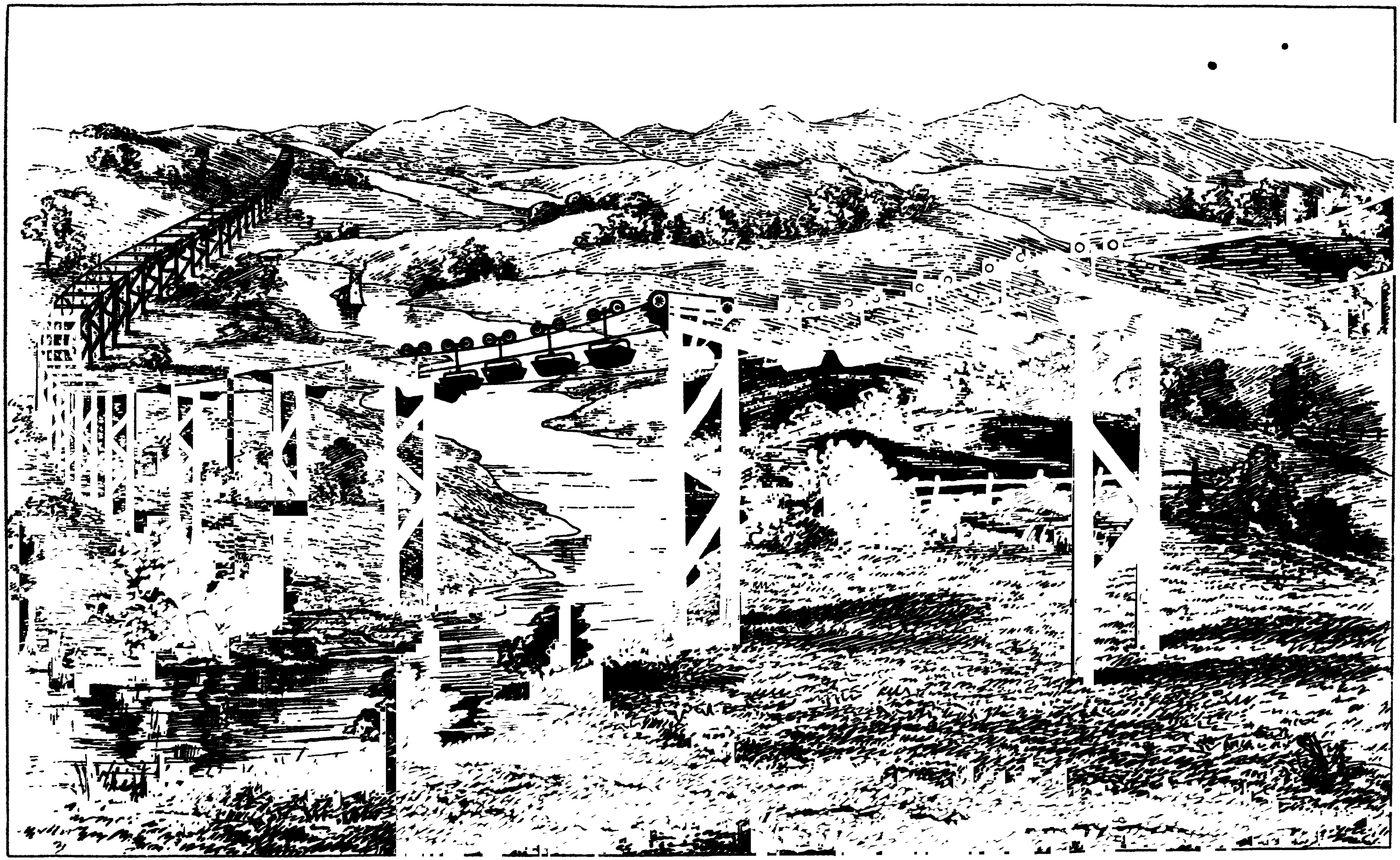
PLATE 2

TELESCOPE.

REFLECTING



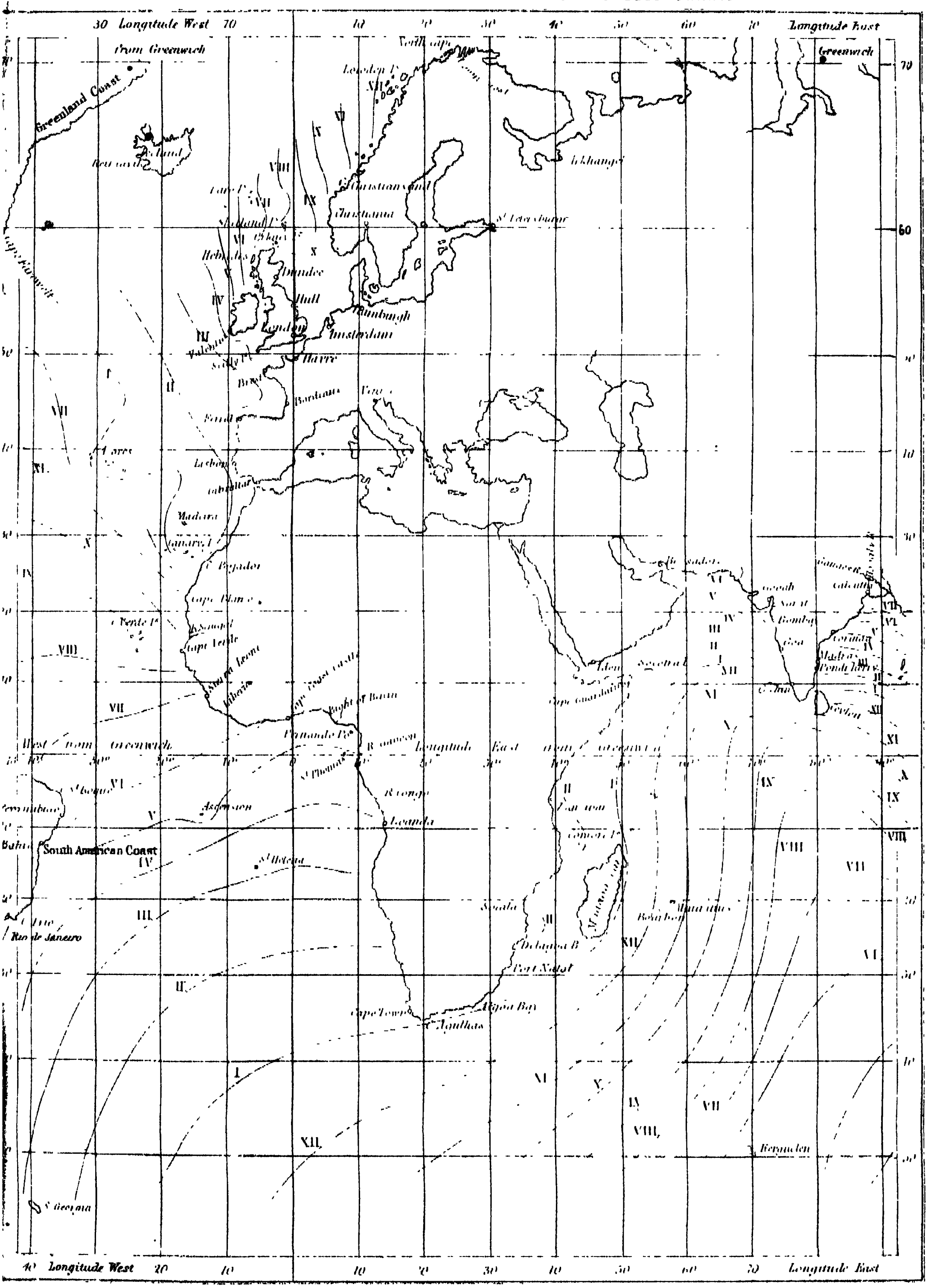
Vol. 13.



D E S.

Plate I

CHART OF CO-TIDAL LINES BASED UPON Dr WHEWELLS CHART.



G. 13.

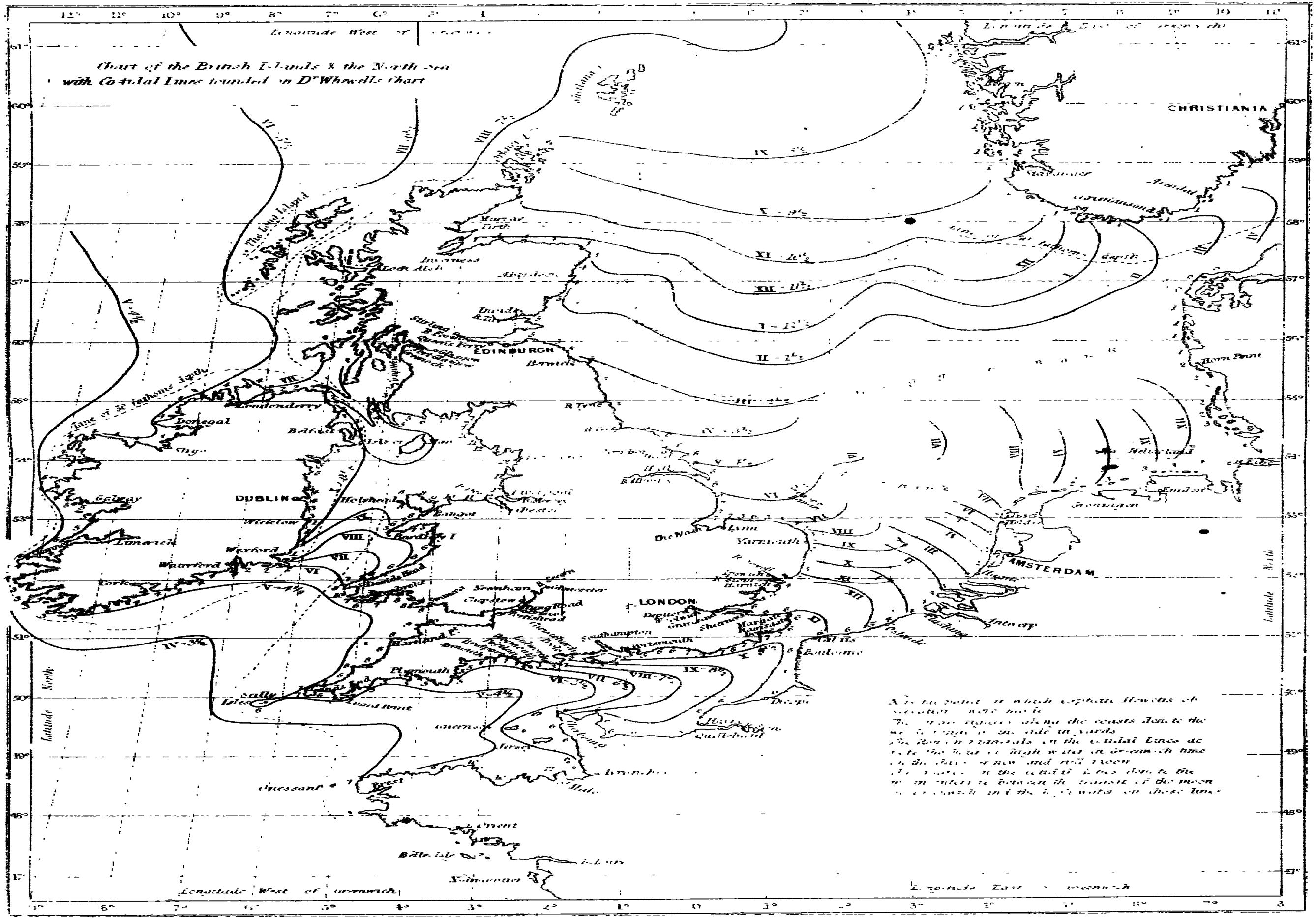
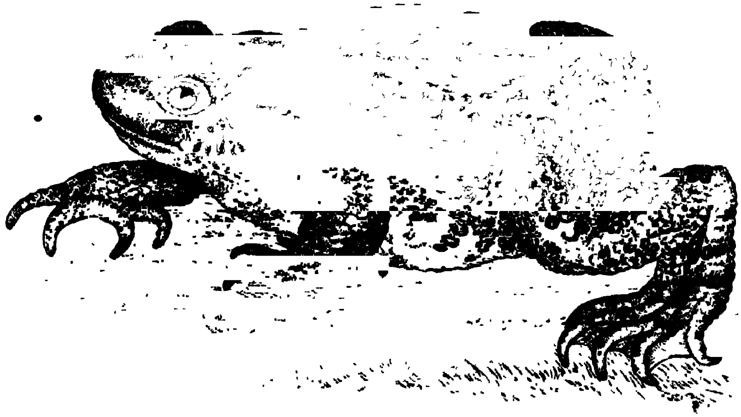
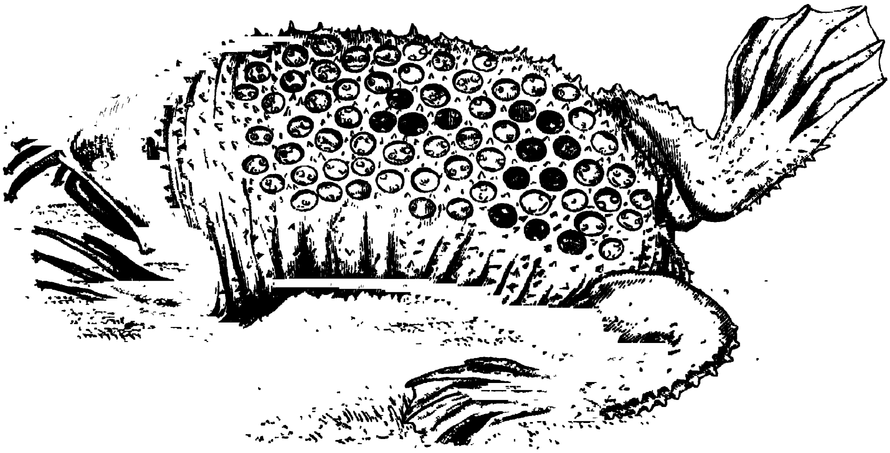


Chart of the British Islands & the North Sea
with Cotidal Lines founded on Dr Whewell's Chart
CHRISTIANIA
EDINBURGH
DUBLIN
LONDON
AMSTERDAM
Longitude West of Greenwich
Longitude East of Greenwich
Latitude North

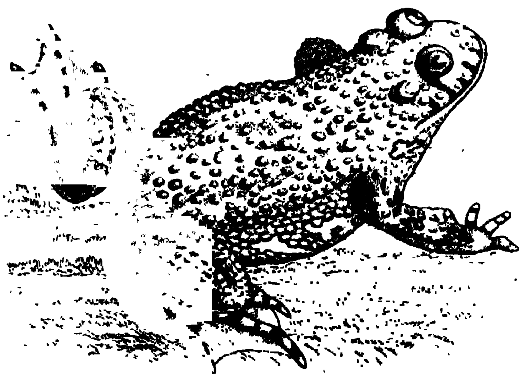
TOADS.



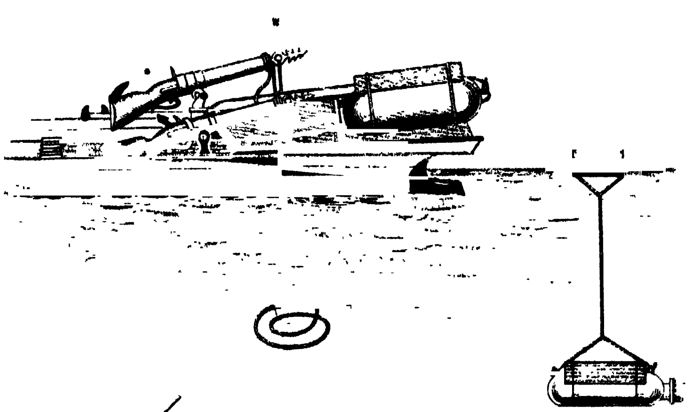
1 Bufo vulgaris __ Common Toad.



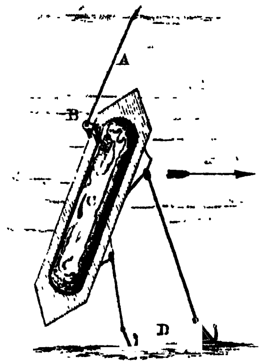
2 Pipa americana. Surinam Toad.



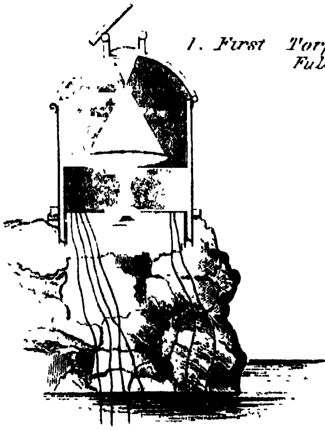
3 Bombinator igneus.___Fire-bellied Toad.

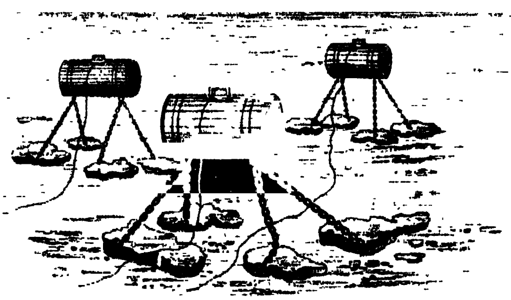


1. First Torpedo, invented by Fulton in 1805.

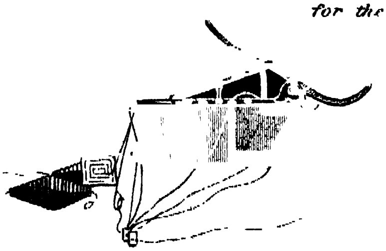


2 Cross-Section of Confederate Torpedo.

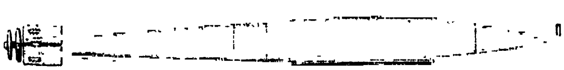




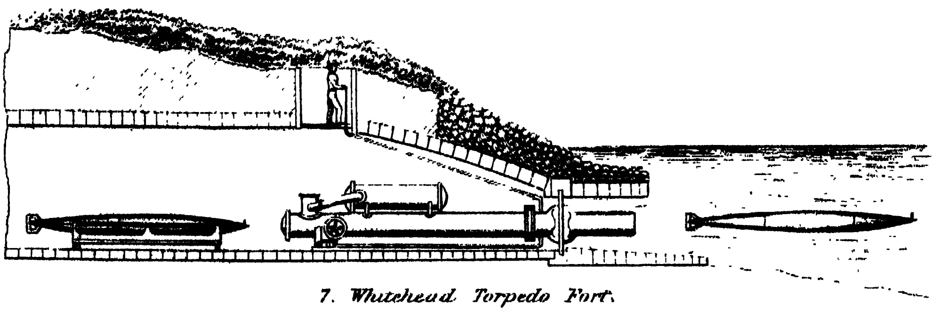
3 & 4 Gun Cotton Electric Torpedo designed for the defence of Venice in 1859



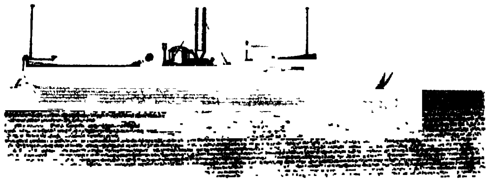
5. Harvey's Torpedo.



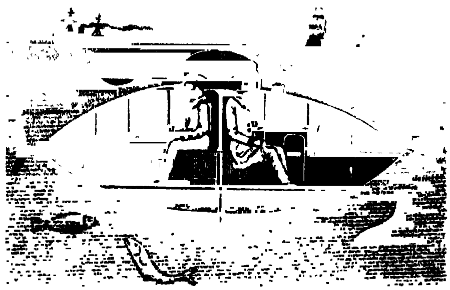
6 Whitehead Locomotive Torpedo Woolwich Pattern



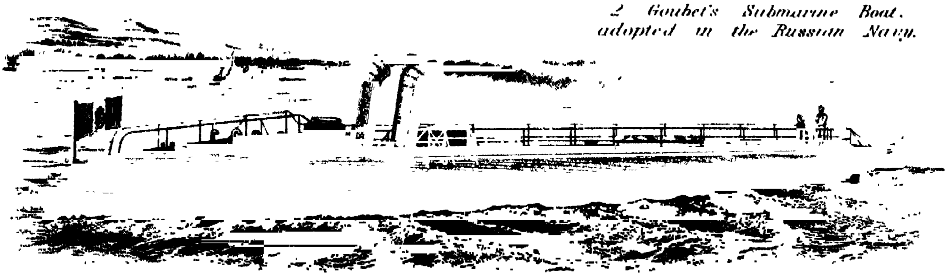
7. Whitehead Torpedo Fort.



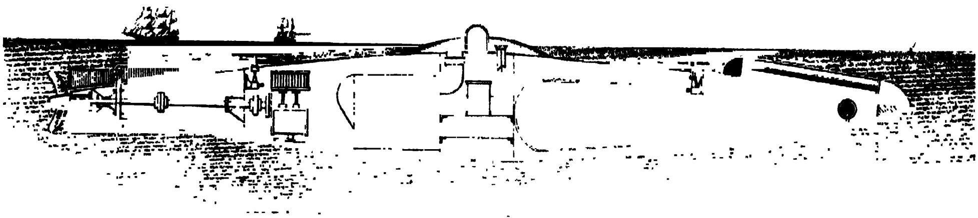
1 Spar Torpedo Boat, First Pattern.



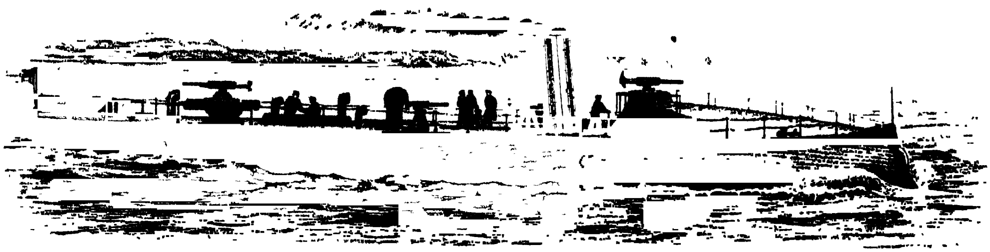
2 Goubet's Submarine Boat, adopted in the Russian Navy.



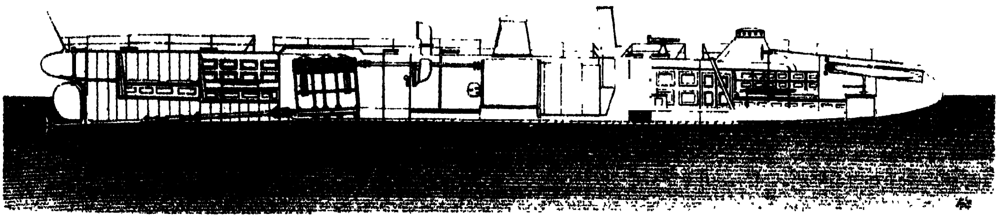
3. Torpedo Boat for the Italian Government.



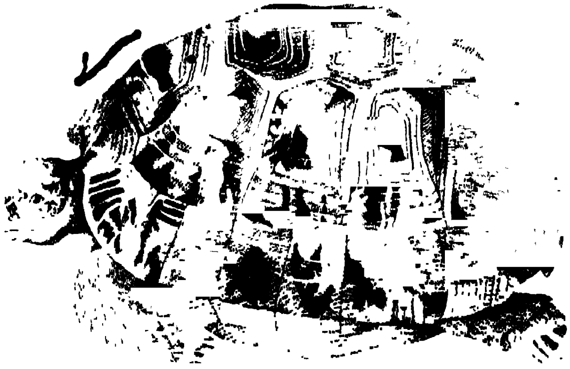
4 Nordenfeldt Submarine Boat



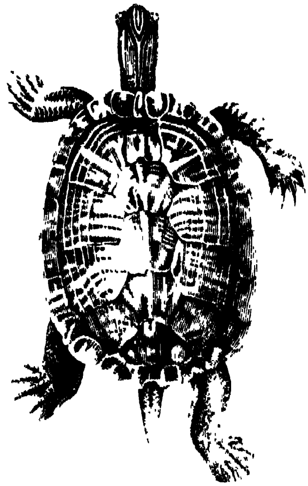
5. Armed Torpedo Boat - "Falke" Type



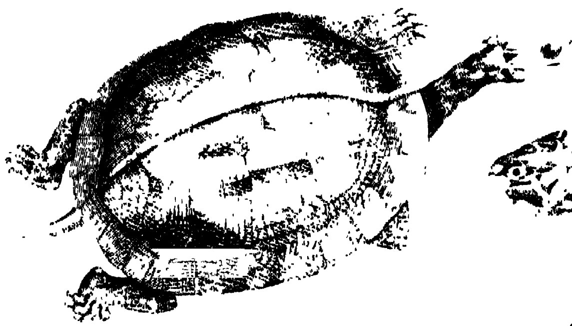
6. Cross-Section of a Yarrow Torpedo Boat.



1 *Testudo græca* Common Tortoise



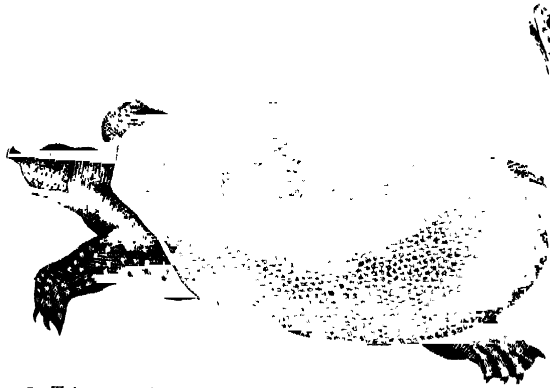
ys scripta Written Tortoi



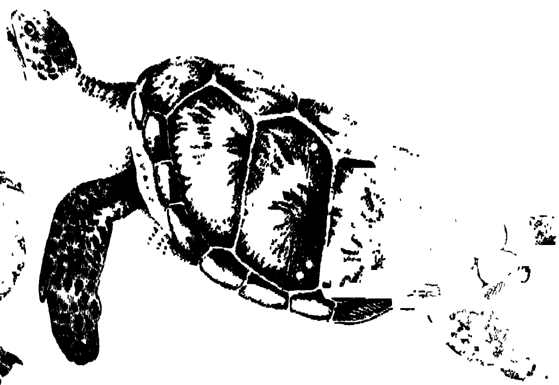
3 *Cistudo trifasciatus* Three striped Box Tortoise.

4 *Chelys matamata* Matamata

Elongation of the snout



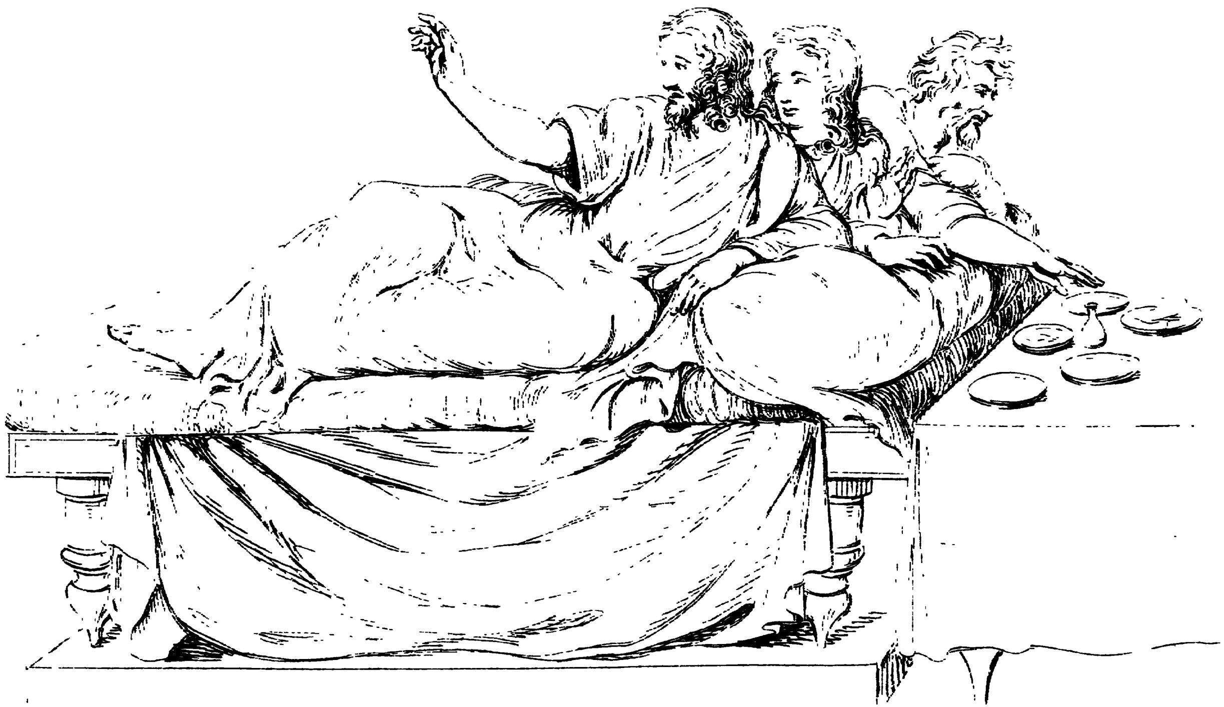
5 *Trionyx niloticus.* — Egyptian Soft Tortoise



6 *Chelonia midas.* Edible Turtle.

T IGLINIUM

CCUBATION.



TRICLINIUM

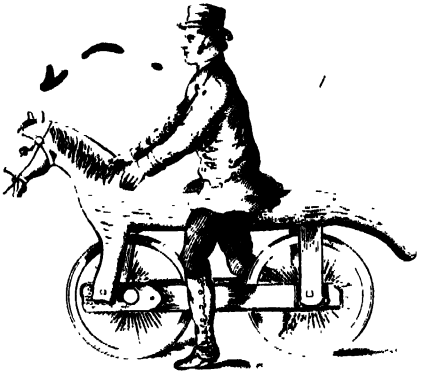
ACCUBATION

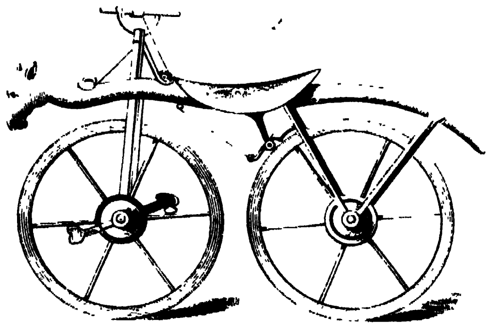
FROM THE "SACRAMENTS" OF POUSSIN IN THE STAFFORD COLLECTION

TRICYCLE.

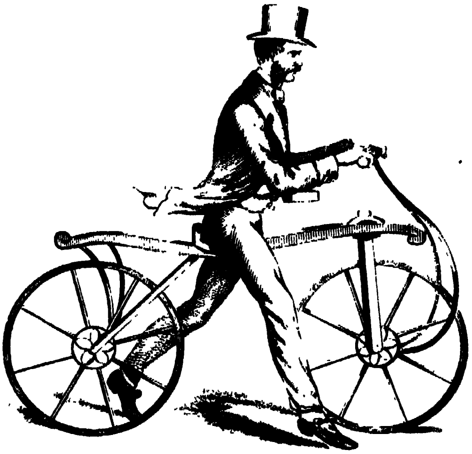
EARLY FORMS OF CYCLES.

PLATE I

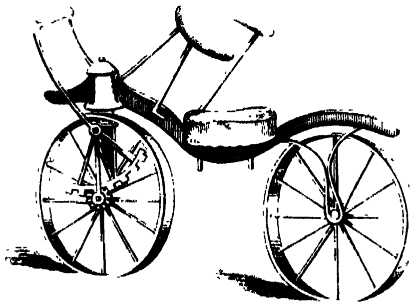




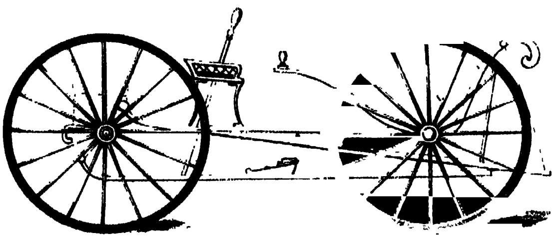
Primitive Bicycles



3 *The "Dandy-Horse*



4 *Gompertz's Velocipede*

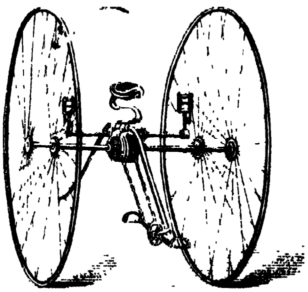


5 *The Dublin Velocipede*

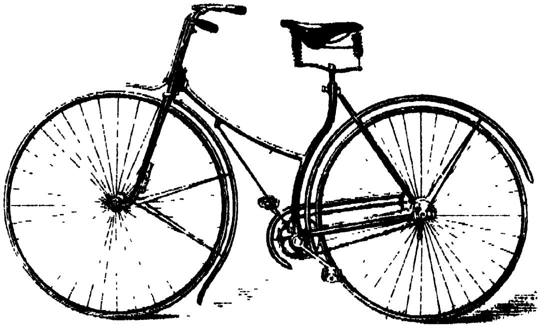
6 *The "Bone shaker*

TRICYCLE.

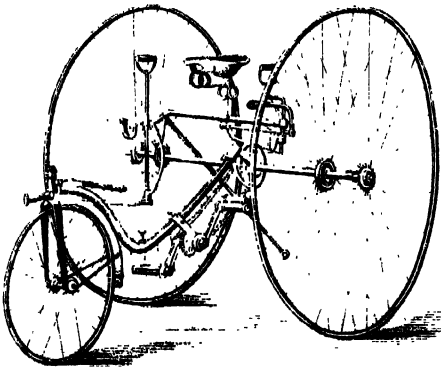
AND OTHER FORMS OF CYCLE



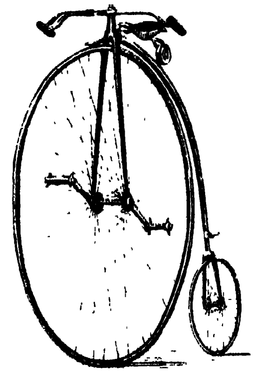
7. The "Otto" Dicycle



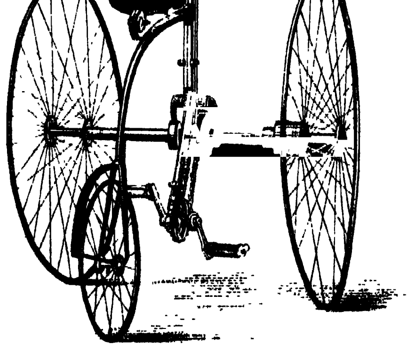
8. The "Rover" Safety



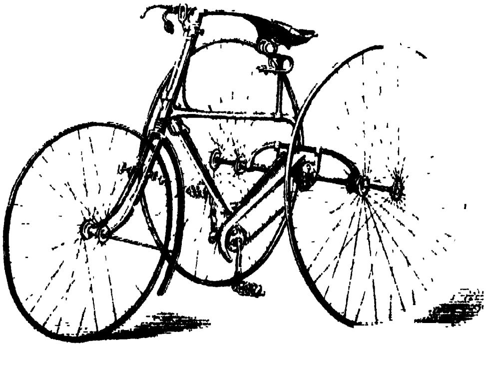
The "Apollo" Tricycle



10. The "King of Clubs"



11. The "Humber" Tricycle.



12. The Singer's "Straight Steerer"

LIST OF PLATES.

VOL. XIII.

To be Bound at Commencement of Volume in Following Order:

NATIONAL ENCYCLOPÆDIA:

A DICTIONARY OF

UNIVERSAL KNOWLEDGE.

SPRING'FIELD, a town of the United States, situated 180 miles south-west of Chicago, at a distance of 5 miles from the Sangamon River, on a large prairie. It is the capital of Illinois, and has fine broad streets and handsome public buildings. The streets are adorned with trees, while many of the houses are surrounded by flower gardens, whence it has been named by enthusiasts the "Flower City." The chief buildings are the capitol, the states buildings, arsenal, county court-house, high school, and opera-house. There are numerous churches and halls, and a monument to President Lincoln. The trade of the town is important, and its mining interests (coal) very large. Its manufactures are also important, and are chiefly flour, steel, and iron, woollen goods, and beer. The population in 1880 was 19,746.

SPRING'FIELD, a town of the United States, in Massachusetts, 120 miles north-east of New York, situated on the Connecticut River. Springfield is one of the prettiest towns in the United States. It is well laid out, and has many handsome buildings. The streets are shaded by trees. The chief buildings are the arsenal, the largest in the United States, and the city hall. Other edifices of importance are the city library, court-house, various churches, &c. The population in 1880 was 37,577, chiefly engaged in the manufacture of arms, &c. The town is an important railway centre.

SPRINGS. The rains which descend from the cloud upon the land, with the melted snows, are partly drained from the surface by rills and brooks, which contribute to form the rivers, discharging finally their contents into the sea. But only a very small proportion of the moisture precipitated is disposed of in this manner. By far the larger portion is returned again to the atmosphere by evaporation, or is devoted to the purposes of animal and vegetable life, or is received into the soil by minute ab sorption, percolating also through cracks and fissures o the surface. Arenaceous and cretaceous strata, with al loose soils and gravels, greedily absorb water, while argil laceous deposits and compact rocks are barriers to its pass age. Hence, on meeting with clays and other impervion beds, the moisture is arrested in its downward course, an there is a resulting over-accumulation in the superincum bent water-bearing stratum. This is forced by hydrostati pressure to find its way again to the surface, whereve there is an outlet, and it oozes from chinks and crevices o the sides of valleys and hills, occasioning the pheno mena of natural springs. In level tracts of country, wher springs of water literally rise, or reach the surface b ascension, the supply is derived from distant elevate grounds, having travelled laterally to the point of dis charge through intermediate pervious strata. Artificia springs, called artesian wells (from the province of Artoi n France, the ancient *Artesium*, where they have been ong in use) are constructed upon the principle involved in he natural law on the subject. [See ARTESIAN WELLS.] It has been applied with remarkable success y the French Algerian government to various parts of the Sahara, where districts formerly dry, arid, and uninhabited have been supplied with water by means of perpendicular borings, and now possess their date-palms, cultivated grounds, and Arab settlements. Many springs are inconstant in their discharge, flowing copiously, then feebly, or altogether failing for a time. These depend entirely for their supply upon the showers that fall upon a limited area of the surface, and are hence affected in this manner by the prevailing character of the season, whether rainy or dry. Other springs are perennial or constant, and pour forth large volumes of water which show little or no diminution from the longest drought. These are obviously quite independent of the last showers that fell, receiving their supplies from vast subterranean reservoirs of water formed by the rains and snows, collected in interior cavities, from extensive areas of the surface, and are not exhausted before they are replenished. St. Winifred's Well, in Flintshire, the most copious spring in England, is estimated to discharge at the mean rate of about 4400 gallons per minute. It has never been known to fail, and is but slightly affected either by prolonged dry weather or excessive rains. Petrarch's Fountain, at Vaucluse, near Avignon, in the south of France, is a spring of dark blue water so abundant as to form at once the river Sorgue, capable at its source of moving machinery, and almost immediately navigable for boats. In some cases springs participate in the ebb and flow of the tide, as at Richmond, where they rise from the arenaceous strata on the banks of the Thames. In other instances they are subject to intermittances at irregular intervals, apparently caused by the water collected in interior cavities discharging by a siphon-shaped channel, and varying in its level. To this class belongs the celebrated Pool of Siloam at Jerusalem. The fact of its ebb and flow was noticed in the fourth century, and after being generally doubted in modern times, except by the native Jews, it was satisfactorily substantiated by Dr. Robertson in 1838.

Owing to the extremely solvent power of water, it becomes more or less charged with the materials in contact with it while percolating through the earth. Hence in the springs of limestone districts the calcareous soil or lime, combined with carbonic acid, is abundantly held in solution, and is frequently deposited in their basins and on their margins, or in the beds of the rills flowing from them, and upon the objects intentionally exposed to their influence. These are the "petrifying" wells and waters of popular speech, so called from their supposed power of

turning into stone whatever substances may be subjected to their action. In all cases where the foreign ingredients have medicinal properties the springs are known as mineral waters, and are variously saline, acidulous, chalybeate, and sulphurous, according to the nature of the substances in alliance with them.

The mean temperature of the springs which are exclusively associated with surface-deposits, corresponds to that of the locality where they are found. But those which rise from considerable depths have a higher average temperature than that of the atmosphere at the place. This is owing to the internal heat of the earth gradually increasing with the depth below the superficial zone to which climate extends its influence. Hence the warm springs which occur in many countries indicate the general depth of the beds from which the water is derived, except in active volcanic districts, where fierce ignition is near the surface, while often visible above it, and hot or boiling springs are common. The hottest springs in Great Britain are at Bath in Somersetshire. Their temperature varies from 117° to 120° Fahr., which is from 69° to 72° above the mean of the neighbourhood. No thermal waters occur in Scotland, nor are they known in England north of Buxton in the High Peak of Derbyshire. The warm springs of the Alps range in temperature from 86° at Naters to 126° at Leuk, while the Ursprung at Baden has a temperature of 153½°. Where there are active volcanoes the range of temperature in the springs varies from a moderate warmth to the heat of scalding water. Messrs. Bunsen and Descloiseaux, in 1846, found the water of the Great Geyser, in Iceland, at the depth of 72 feet in the funnel, nearly 30° above the boiling point. The North Island of New Zealand, in its volcanic district, is very remarkable for its boiling ponds (of large dimensions) and scalding springs.

It was believed by the old Egyptians and Greeks that the Fountain of the Sun, *Fons Solis*, close to the temple of Jupiter Ammon, in the Lybian Desert, experienced diurnally a change of temperature, being cool by day and warm by night; but this change is of course apparent only, arising from the strongly-contrasted temperature of the external air in a tropical climate at noon and at night. Under the burning heat of the mid-day sun the water will seem cool to the fevered hand, and warm at night, when the atmosphere is chilled.

SPRIT (Dutch *spriet*), a pole or spar used diagonally to extend a sprit-sail, which is a large fore-and-aft sail. The sprit is fixed to the mast by a coil of rope, and stretched across the sail to its aft upper corner, so as to keep it open to the wind.

SPRUCE BEER, a fermented liquor made from the leaves and small branches of the spruce-fir (*Abies nigra*) with sugar or treacle. There are two kinds of spruce beer, the brown and the white, of which the latter is considered the best. In the manufacture, essence of spruce is fermented much in the same way as grape-juice in wine-making. In places where spruce firs abound, a simple decoction of the leaves and small branches is used instead of the essence. It is a wholesome beverage, and is often found useful as an antiscorbutic during long sea-voyages. If made with 1¼ to 1½ lb. of lump sugar per gallon it may be kept for twelve months or longer in a moderately cool place. About 65,000 gallons are annually imported into the United Kingdom, chiefly from Prussia.

SPRUCE or **SPRUCE FIR** is the name given to several species of coniferous trees belonging to the genus Abies.

The Common or Norway Spruce (*Abies excelsa*) is a native of Northern Europe, extending into Siberia beyond the arctic circle. In Norway and Sweden it is especially abundant. When growing singly the spruce has a most striking and beautiful appearance, with its pyramidal form and long drooping branches touching the ground. It grows to a height of from 80 to 150 feet. The leaves are dark green, awl-shaped, and four-sided, scattered in insertion on the branches, and pointing in every direction; the cones are cylindrical, from 5 to 7 inches long, hanging from the ends of the branches; the seeds are very small. The Norway spruce has been cultivated since 1548 in England, where it is quite hardy, but only occasionally grows to the perfection which it attains in Norway. It flowers in May, and the cones ripen in the following spring, soon after which they commence shedding their seeds. It thrives in moist soils, growing most luxuriantly in deep loams and low situations; it also succeeds well on acclivities with a north-east aspect and a moist sandy soil, in which situations, as at Blair and other places in Scotland, it produces timber as strong and durable as that imported from Norway (Loudon). It becomes stunted in plantations where the trees are crowded together. The wood is light, elastic, fine-grained, and durable, of a reddish or yellowish white, and less resinous than that of the Scotch fir. It is known in commerce as "white deal," and is imported from Norway in large quantities. It is largely used for masts, oars, spars, scaffolding-poles, and ladders; sawn into planks it is employed for floors, packing-boxes, musical instruments, &c. The bark is used for tanning. The resin, obtained by making incisions in the bark, forms the Burgundy pitch of commerce. There are numerous varieties of the Norway spruce in cultivation.

The Black Spruce (*Abies nigra*) is found in North America from Canada to Carolina, being partial to cold swampy localities among the mountains. It grows to a height of from 60 to 75 feet, and has a handsome conical head, without the gloomy aspect of the Norway spruce, as the branches spread almost horizontally. The leaves are short, erect, and very dark green; the cones are ovate, from 1 to 1½ inches long, with notched rounded scales; they are pendulous from near the end of the branches. The wood is very strong, light, and durable, and much used in shipbuilding, not only for masts and spars, but in the hull. It has been cultivated in this country since 1700. A variety called the Red Spruce has larger and redder cones, and the wood tinged with red.

The White Spruce (*Abies alba*) has a similar range to the black spruce. It is a smaller species, between 40 and 50 feet high, and distinguished by the bluish cast of its foliage, which gives it a much lighter appearance. The leaves are less numerous, longer, and of a pale bluish-green. The wood is valuable, but inferior to that of the black spruce. From the fibres of the roots the Indians prepare threads with which to sew their birch-bark canoes. This species has been cultivated in England since 1700.

The Douglas Spruce Fir (*Abies Douglasii*) is a large tree, native of the forests of the north-west coast of North America. It grows to a height of from 100 to 180 feet, and has large flat leaves, deep green above, silvery below, and large oblong cones. The bark is thick and rugged, and abounds in balsamic resin. The wood is heavy, firm, with few knots, and yellow in colour. It succeeds well in woods and parks in this country, into which it was introduced in 1826.

The Hemlock Spruce (*Abies canadensis*) is a noble tree, found on the highest mountains in North America, where it grows to a height of from 60 to 80 feet. It has small flat leaves arranged irregularly in two rows, and very small oval cones containing very small seeds. When young the hemlock spruce is the most graceful of all the fir tribe, from the symmetrical arrangement of its drooping branches and its light tufted foliage. It is largely cultivated in England as an ornamental tree, but does not attain any considerable height in this country. The wood is of little value, being neither sound nor durable. The bark is exceedingly valuable for tanning. The hemlock spruce is

of slow growth; it bears clipping well, and is well adapted for the construction of quick-hedges.

Several other species of spruce firs, from the Himalayas, the Caucasus range, and North America, are cultivated in England.

SPUR RYAL, a gold piece coined by James I., and bearing a spur upon the reverse. Its value was 15*s.* It was the half of the double ryal and of the sovereign, both valued at 30*s.* in that reign. This was one of the first coins to bear its value in numerals as part of the design.

SPURGE. See EUPHORBIA.

SPURGE LAUREL. See DAPHNE.

SPUR'REY (Spergula) is a genus of plants belonging to the order CARYOPHYLLEÆ. There are two or three species, annual slender herbs, from temperate Europe and Asia. *Spergula arvensis* (the corn spurrey or yarr) is a native of Europe and Western Africa, in gardens and fields. It has been introduced into North America, and is common in Great Britain in cornfields. Though not cultivated in England, this plant is of some importance on the Continent, and in the Netherlands and Germany is sown for fodder. It is said to be well adapted for light sandy soils. It is a straggling weed about a foot high, with weak ascending stems, slightly downy, and leaves an inch or more in length, in two opposite clusters, with small stipules. The small white flowers grow in terminal cymes; they have five sepals, five entire petals, five or ten stamens, and a one-celled ovary with five distinct styles containing many ovules. The fruit is a capsule opening in five entire valves, and the seeds are compressed, surrounded with a membranous wing or margin. Another species (*Spergula pilifera*) is frequently grown on lawns as a substitute for grass, as its foliage is of a good colour and delicate texture, and retains its verdure even in the driest weather.

The Sand Spurrey (*Spergularia rubra*), belonging to a nearly allied genus, is found in gravelly and sandy soils in Britain. It is a prostrate weed with much-branching stems and small rose-coloured flowers. There are several other British species of the same genus, all neither useful nor ornamental.

SPURS, BATTLE OF THE, fought at Guinegaste, near Terouenne, 16th August, 1513, between the English, 30,000 strong, with a small body of Germans, under Henry VIII. of England and the Emperor Maximilian, against a superior force of French, under the Duc de Longueville. The latter were signally defeated, and the battle was called the "Battle of the Spurs" because the French used their spurs (in retreat) more than their swords (in the fight).

SPURZ'HEIM, JOHANN GASPAR, who shares with Gall the honour (if it be one) of the invention of phrenology, was born near Trier (Trèves) on the last day of the year 1776. He became a medical student under Gall at Vienna, and assisted him in his celebrated dissections of the brain, for which he certainly deserves gratitude, even from those who refuse to accept his deductions from the observed facts. In 1806, having long worked at the new doctrine, localizing the various mental powers and feelings, each in its own organ or convolution of the brain, and professing to recognize the shape of these organs from the external shape of the skull, Gall and Spurzheim travelled in Germany and Switzerland, and arrived towards the close of the year in Paris. In 1808 their joint memoir on the "Anatomy of the Nervous System, especially that of the Brain," was presented to the Institute, and the first volume of their great work with the same title appeared in 1810. In 1813 they quarrelled and separated. Spurzheim came to England, and published English works on the new system ("Physiognomical System of Drs. Gall and Spurzheim," "Outlines of Physiognomy," &c.), and a treatise on "Insanity." He replied to his critics by dissecting the brain in public, which gave him an easy victory, for he was a skilled brain-anatomist, and but few English surgeons of the time knew much of the subject. His "Examination of Objections," &c., was published in 1817, at Edinburgh. Here he made the acquaintance of George Combe, who at once became an ardent disciple of phrenology. Spurzheim went back to Paris in 1817, but returned to England in 1825 (when he published his "Phrenology"), and lived there till the year of his death. He went to America, visiting first Boston, on a lecturing tour in 1832, and died there after a short illness.

SPY, in war, is the name given to a person employed to obtain by surreptitious methods information regarding the enemy. The practice of employing persons of this description in warfare is a very ancient one, as we may learn from the books of the Old Testament, and it is followed openly by all modern commanders. All sorts of disguises are resorted to by professional spies, in order to enable them to penetrate into an enemy's camp, and disguise of some sort is generally regarded as an essential characteristic of a spy. Thus it is generally accepted as a principle of international law that an officer or soldier cannot be treated as a spy in any circumstance if he had on his uniform when apprehended. A certain number of trained spies form part of the intelligence department of most modern armies, and they form when efficient very useful auxiliaries to the fighting forces. They are usually men of superior ability, who are willing to accept the dangers of the occupation, either from motives of patriotism, the promise of high pay, or of a combination of both motives. While, however, it is generally admitted that spies may be employed without dishonour on the part of a commander, it is equally a principle of international law that a spy when detected may be summarily and ignominiously put to death, and as a rule spies when caught are hanged without mercy and with but little delay. The spies of both sides played an important part in the Civil War of the United States, and more recently it may be asserted that no small portion of the success of the Prussian armies in the wars with Austria and the German Bund in 1866, and with France in 1870–71, was owing to the efficiency of their "intelligence department." This was a branch of their marvellously complete organization, the members of which frequently performed the part of spies as a portion of their regular duty. No degradation was in consequence supposed to attach to the dangerous office, those who filled it being regarded as necessary and important to the military operations, rather than as mercenary spies. The department is fully described, among other organizations of the German armies, in Captain Hozier's "History of the Franco-German War."

SQUAD, diminutive of *Squadron*, is a term applied to any small body of men assembled for drilling purposes. Recruits, on their entering the army, and before they are able to perform any military duties, are placed in what is called the *Awkward Squad.*

SQUAD'RON, the principal division (one-third or one-fourth) of a regiment of cavalry. Its numerical strength has varied at different times, but at present it ranges in strength from 120 to 200, of whom about one-sixth are not under arms. This body of men is divided into two troops, each of which is commanded by its captain, who has under him a lieutenant. The word is supposed to be derived from *squadra* (Italian), which is itself corrupted from the Latin word *quadratum. Acies quadrata* denoted a body of men drawn up in a square form. In naval affairs, a squadron is a small number of war-ships, either forming part of a fleet or acting independently, and generally commanded by a rear-admiral or commodore.

SQUALLS are sudden and violent, but transitory storms, most often occurring at sea. From their small extent and brief duration they have as yet been very ineffi-

SQUARE.

ciently studied. It is difficult to ascertain the variation of barometric levels, &c., because two ships are rarely caught in the same squall. There are two varieties of squalls which are well known. These are the *White Squall* and the *Arched Squall.* The first lies low, the wind blowing along the surface of the sea and lashing it into a sheet of white foam, whence its name. The second lies high: the dark clouds are driven into a firm arch, beneath which the wind rushes with fury, accompanied by a deluge of rain and by a powerful electric discharge. Of this latter kind are the celebrated TORNADOES of West Africa.

SQUARE. It is evident that the old English meaning of this word had reference only to the corners of a figure, or at most to right-angled corners. The old word for a square figure is a *four-square* figure; the carpenter's rule for drawing a right angle is called a T-*square* to this day. The French word *équerre* (anciently *esquerre*, originally derived, like the Italian *squadra*, from *quadratum*) is the immediate origin; and this (in French) means also an instrument for drawing a right angle. In Recorde's "Ground of Arts," the earliest English geometry extant, he calls what is now a square by the name of *square quadrate* (*square*, right-angled; *quadrate*, four-sided figure); and it is not until he is considerably advanced in his work that he seems to find out that he may drop the second word and retain the first only. There was still an incorrectness, for a square figure should have meant one having all its angles right angles, that is, what we now call a rectangle, whether its sides were equal or not. To complete the proof of connection between the square and the right-angled corner, we may mention that a right-angled triangle and a gnomon are used by carpenters as "squares," and when wood is faced to a right angle it is said to be "squared-up."

Square.

In geometry a square means a four-sided plane figure with all its sides equal and all its angles right angles. A square is divided by either of its two diagonals into two isosceles right-angled triangles; its diagonals are equal, and bisect each other at right angles. In arithmetic or algebra a square signifies the number produced by multiplying a number by itself. The reason of the double meaning is obvious enough. A square of 7 miles long contains 7×7 square units; so that the operation 7×7 is the arithmetic of finding the content of a square of 7 units in length and 7 in breadth. Or if a side of a square contains a units, the area of the square is aa (expressed as a^2) units.

Square Root is the name given to a number with reference to its square. Thus, 49 being the square of 7, 7 is the square root of 49. When an integer has no integral square root it has no square root at all in finite terms; thus 2 has no square root. But since 1·4142136 multiplied by itself gives very nearly 2, or has a square very near to 2, it is customary to say that 1·4142136 is very nearly the square root of 2: more properly it should be styled the square root of something very near 2.

Since the square of 1 is 1, the square of 10 is 100, the square of 100 is 10,000, and the square of 1000 is 1,000,000—it appears that a power of 10 is squared by doubling its ciphers. Therefore any number between 10 and 100 will have a square containing either three or four digits; and in general any number of one figure will have one or two digits in its square; the square of any number of two figures will have three or four digits; that of any number of three figures will have five or six digits, and so on.

If we multiply $a + b$ by itself we obtain as product $a^2 + 2ab + b^2$; whence we see that the square of the sum of two numbers is equal to the sum of their squares added to twice their product. This also appears arithmetically and geometrically. For let there be two lines, one containing 5 and the other 3 inches. Then their sum is 8 inches and the square of their sum is 64 (square) inches. Now the square of 5 is 25, and that of 3 is 9; and $25 + 9 + 30 = 64$: but 30 is twice 5×3. In the figure the squares of 5 and of 3, and the two rectangles contained by 5 and 3, together are seen to make up the whole square of $5 + 3$ taken together.

Square of uantities eq s sum of
juares + tw product.

Now, putting these two considerations together we may easily extract the square root of any given number, or a nearly approximate integral or fractional number to it, supposing it to have no exact square root. For let it be desired to extract the square root of 15,129. We at once see that it must have three figures, and that the first or hundreds figure is 1. This then forms our first digit, or $a = 100$. It remains to find b, which must undoubtedly be much less than a.

```
                   1'51'29(100
                   1 00 00
100 × 2=200,       51 29(20
          20|
        4000|
 20 × 20=400,
        4400|      44 00
120 × 2=240,        7 29(3

         720|
   3 × 3=  9|
         729|      7 29         Ans. 123
```

We know that $a^2 + 2ab + b^2 = (a + b)^2 = 15{,}129$. We therefore first deduct a^2 (10,000) and try $2a$ (instead of $2ab$, neglecting b, which we do not know, but which must be small) as a trial divisor on the remainder.

Now, $2a = 200$, and suggests 20 as b: which gives us $2ab = 4000$, and $b^2 = 400$: therefore $2ab + b^2 = 4400$. Evidently b is too small, but it is exact enough for the tens place. We have now 120 as our approximate square root, and find, after deducting $120^2 = 14{,}400$, that we have left still 729 unaccounted for. Passing to the third step we take 120 as a fresh a, and proceed to find a fresh b. The new $2a = 240$, which, used as a trial divisor, suggests 3 for the integer's place: and taking b therefore as 3 we get $2ab + b^2 = 729$, which we see to be exactly the figure we required. The answer is therefore $a + b$, that is, $120 + 3$, or 123; for $a^2 + 2ab + b^2 = 14{,}400 + 720 + 9$, when $a = 120$ and $b = 3$.

Algebraic equations involving squares are called QUADRATIC EQUATIONS.

SQUARE, in military technics, a body of men drawn up in a rectangular or four-sided figure, either one, two, or more ranks deep. This formation was largely adopted by the Duke of Wellington at Waterloo, and before the days of breechloaders it was peculiarly useful in resisting cavalry attacks. In the centre stand the officers, horses, colours, &c. The front rank kneels, and the two next stoop, so that five ranks of men can keep up a constant fire upon an approaching enemy. Should that enemy waver and begin to retire, the square may be deployed, that is, thrown into line, and then, charging rapidly, complete with the bayonet the discomfiture commenced by their well-delivered fire. It is probable, however, that the square will be but little used in future warfare between civilized adversaries, owing to

the alteration made in tactics to meet the development of small-arm fire. For some forms of savage warfare it still remains very useful, as the events of the Soudan campaigns of 1884–85 fully proved.

SQUARING THE CIRCLE. See QUADRATURE OF THE CIRCLE.

SQUASH. See GOURD.

SQUID and **CAL'AMARY** are the common names given to the species of Teuthidæ, a family of cephalopodous molluscs belonging to the section Decapoda (CUTTLE-FISH). The squids possess an elongated body with a pair of short, broad terminal fins. There are eight arms, covered generally with two rows of suckers, which are stalked and bordered with a horny, finely-toothed ring; the two tentacles are usually much longer than the arms, and have expanded club-like extremities covered with suckers. The internal shell is a delicate, horny, quill-shaped plate with two lateral expansions; it is called the *pen* or *gladius*.

The Common Squid (*Loligo vulgaris*) is common on British coasts, occurring in shoals on the Cornish coast, where the fishermen take it for bait. The body is a foot or a foot and a half long, cylindrical, tapering behind and much elongated in the males, with the fins united at the base of the body. The eyes are large, movable in their sockets, and covered with skin. The tentacles are partly retractile, and have four rows of suckers on their expanded tips. The squids are gregarious. They swim with great rapidity, and can also creep head downwards on the bottom of the sea. They prey on fishes, crustaceans, and molluscs. The ink-bag is well developed, and from it they readily discharge an inky fluid when alarmed, in order to cover their retreat. There are about twenty species of Loligo, found in all seas.

Sepiola rondeletii is a very small squid, only 2 or 3 inches long, sometimes taken in shrimp-nets on the south coast of England. It has a short purse-like body, with rounded fins placed high up on the body. It buries itself up to the eyes in the sand.

Loligopsis, which occurs in the North Sea, the Atlantic, Mediterranean, &c., has an extremely elongated tapering body with short arms.

Cherioteuthes has a body from 2 to 4 inches long, while the arms measure 6 or 8 inches, and the tentacles between 2 and 3 feet. The tentacles are very slender, not retractile into the cavities under the orbits, and have scattered suckers along their stalks, and four rows of stalked claws on their expanded extremities. There are two species, one of which occurs in the Mediterranean.

The Clawed Calamaries (Onychoteuthis) are remarkable for the curious structure of their tentacles. These organs, which are very long and powerful, have the suckers on their extremities furnished with a double series of long curved sharp claws. In addition, at the base of the extremity of each tentacle is a cluster of small simple unarmed suckers, by which the tentacles can be interlocked and their united strength applied to drag to the mouth any resisting object which has been seized by the clawed suckers. The obstetric forceps invented by Sir J. Simpson, in which either blade can be used separately, or, by the interlocking of a temporary joint, be made to act in combination, is said to have been suggested by this curious contrivance. These clawed calamaries attain a length of 2 feet. They are solitary animals, frequenting the open sea, and especially the banks of floating gulf-weed in the Atlantic.

The Armed Calamaries (Enoploteuthis) have no suckers on their arms, which are replaced by a double series of curved horny hooks concealed by retractile webs. The tentacles are long and feeble, and have only small hooks on their extremities. The species are found in the Mediterranean and Pacific, and some attain a large size in the latter ocean.

The FLYING SQUIDS or Sagittated Calamaries (Ommastrephis) are so called from their rapid movements and habit of leaping out of the water, often to such a height as to fall on the decks of ships.

Gigantic Squids have been met with on the North Atlantic coasts with bodies from 10 to 15 feet long, measuring to the extremities of the tentacles 40, 50, or even 60 feet. Most of these have been referred to the genus Architeuthis, of which two species, *Architeuthis dux* and *Architeuthis monachus*, have been described. These gigantic squids, with their enormously long tentacles, may have given rise to some of the stories about the great sea-serpent which is said to be periodically seen in the North Atlantic.

SQUILL (Scilla) is a genus of plants belonging to the order LILIACEÆ. About eighty species are known, chiefly from the Mediterranean region and Western Asia. They are bulbous herbs with radical linear leaves, and racemose, blue or purplish flowers, which have a spreading bell-shaped or tubular perianth, and six stamens inserted on the perianth. The Spring Squill (*Scilla verna*) is a beautiful little plant 4 to 6 inches high, with long narrow leaves and corymbose racemes of small bright-blue fragrant flowers. It is found in rocky pastures and wastes on the western coast of England, in the east of Scotland, and especially in the Orkney and Shetland Islands; it is very rare in Ireland, and in Europe is found on the coasts of Norway, France, and Spain. It flowers in April or May. The Autumn Squill (*Scilla autumnalis*) only occurs in Britain on rocky pastures in the southern counties of England; it is a rather larger plant, with reddish-purple flowers, which appear in autumn. The common bluebell or wild hyacinth is now usually referred to this genus, under the name *Squilla nutans*; it is found in woods, hedges, &c., throughout England, Ireland, and in the south of Scotland.

The Officinal Squill (*Urginea maritima*) belongs to a nearly allied genus, distinguished by the more widely-spreading segments of the perianth, and by the more numerous seeds. It is a native of the Mediterranean region. It has a large pear-shaped onion-like bulb, long, flat, spreading leaves, and a scape about 2 feet high, bearing a long dense raceme of white flowers. The officinal part is the bulb, of which there are two varieties: the one large and whitish externally; the other smaller, of a brownish-red colour. The former is preferred in England, the latter in Germany. The bulb abounds in an acrid mucilaginous juice, with an alliaceous odour, and a bitter acrid nauseous taste. It is imported whole, or more usually cut in slices and dried. Its properties are due to a principle called scillitin. It has been used medicinally from a very early period. It is imported into Britain from Malta and other parts of the Mediterranean, and also from St. Petersburg and Copenhagen.

Squill in a large dose is unquestionably poisonous, but in many cases it fortunately acts as its own antidote, by causing vomiting. But even in a moderate dose it may still do much harm, by its stimulating effects, if prematurely employed, as it often is, as a popular or domestic medicine in the early stages of colds and coughs. It is for the second stage alone of these that it is suited. It augments the secretion from most mucous surfaces, and also stimulates the kidneys, and sometimes the skin.

SQUIL'LA. See STOMATOPODA.

SQUINTING (*Strabismus*). It is a condition essential to correct vision that the axes of both eyes correspond in direction, and be turned simultaneously towards the object we regard. Now to insure the fulfilment of this condition, the orbital muscles (*motores oculorum*) are so supplied with nervous influence that we cannot will the movement of one eye without the other being called into involuntary and harmonious action. There are some individuals, however, whose optic axes are not parallel, and

whose eyes do not move in harmony with each other; such persons are said to squint, or to be affected with strabismus. Squinting may take place either upwards, downwards, inwards, or outwards, or in the intermediate directions; it may also be confined to one eye, or it may affect both.

Causes.—Among the remote causes which unquestionably contribute to this effect, may be enumerated convulsions, teething, the irritation arising from worms, ophthalmia, imitation, a habit of misdirecting the eyes, as by frequently looking at a mole on the nose, &c. The proximate cause resides in some affection of the muscles or nerves of the eyeball; either the balance of power between the former is lost, or the sympathy which exists naturally between the motor-oculi nerves of the two eyes is impaired.

Treatment.—This must depend upon whether the affection is of a temporary or permanent nature; in the former case it will be found to arise from some local irritation, and can be removed by suitable therapeutic remedies; in the latter, an operation will generally be required. Among the different other plans of treatment which occasionally have proved successful, we may enumerate binding up the sound eye; the employment of spectacles having glasses of different power; blinders projecting in front of the temples, with a view of attracting the eyes outwards; electricity, &c. The operation for the cure of strabismus is said to have suggested itself first to Dr. Stromeyer, from witnessing the success of tenotomy in contractions of the limbs. Dr. Dieffenbach, of Berlin, however, was the first who had the boldness to carry it into practice on the living subject. The operation consists in dividing the muscle by which the distortion is produced, and thus allowing its antagonist to draw the eye again into the centre of the orbit. In the majority of cases the operation is attended with success, but in some instances two or three repetitions are necessary in order to obtain a perfect cure.

SQUIR'REL (Sciuridæ) is an extensive family of Rodentia found all over the world, except in the Australian regions. The squirrels are distinguished by the possession of five rooted tuberculated molar teeth on each side of the upper jaw, the first being very small and sometimes deciduous, and four molars on each side of the lower jaw, and by the presence of post-orbital processes. The incisor teeth are two in each jaw, those in the lower jaw being compressed and smooth. The fore feet have five toes,

The Common Squirrel (*Sciurus vulgaris*).

the thumb on the fore feet being often rudimentary; all the toes are furnished with curved, compressed claws. The clavicles are perfect, and the bones of the forearm distinct, allowing of great freedom of movement.

The family Sciuridæ is divided into two subfamilies, Sciurinæ, containing the true squirrels, and Arctomyinæ, containing the Marmots.

The Common Squirrel (*Sciurus vulgaris*) may be taken as a type of the true squirrels. Its general characteristics are familiar to all; its fine full eyes, its elegant contour, its activity, its deep soft fur, tufted ears, and long bushy tail have contributed to render it a general favourite. The squirrel is about 14 or 16 inches long, of which the tail measures about half. The fur has a rich brownish-red colour, generally being white under the throat and belly. But even in this country the fur becomes mixed with grayish hairs in the winter, while in the extreme north the whole upper surface acquires a grayish tint at this season, yielding then the much-prized fur called miniver. In the Alps and Pyrenees a variety occurs with the fur of the back dark brown, speckled with yellowish-white. The ears are beautifully pencilled at the tips with long delicate hairs. The tail is long and bushy, the hairs being disposed laterally, and is usually carried over the back.

The common squirrel is distributed all over Europe and Northern Asia. It frequents woods and forests, living principally among trees, and rarely descending to the ground. It is extremely active and graceful in its movements, leaping from bough to bough with astonishing agility, and climbing the tree with equal rapidity if surprised on the

ground. It feeds on nuts, beech-mast, and acorns, and in spring often on the young bark, buds, and tender shoots of trees, especially of the spruce and silver firs. It sits on its haunches to eat, holding its food in its fore paws, which thus serve the office of hands. In eating nuts it gnaws with its strong incisor teeth through the hard shell, and then carefully removes every particle of the dry brown skin from each portion of the kernel before it is eaten. Sometimes also it plunders the nests of birds, as the wood-pigeon, and devours the eggs. In the autumn the squirrel gathers a store of nuts and acorns, and hides them in holes of trees near its retreat as a provision for winter. During the greater part of this season it remains in a state of almost complete torpidity, coiled up in the hole of a tree, and covered by its bushy tail; on fine days it wakens up from its slumber, and feeds on portions of its treasured hoards. The squirrel is monogamous, pairing for life, and frequenting the same tree for many years. The female brings forth in June three or four young, and rears them in a carefully constructed nest. This is formed of vegetable fibres, moss, leaves, &c., and is placed either in the hole of a tree or in the fork of two or more branches, so as to be concealed from view. The young remain with the parents until the following spring.

The species of the genus Sciurus, which contains the Tree Squirrels, are very numerous and widely distributed, especially in the warmer parts of Asia. There are several North American species, agreeing generally with the common squirrel in their habits. The largest of these is the Fox Squirrel (*Sciurus niger*), which is about 27 inches long, of which the tail measures 15 inches. The fur is coarse and harsh, varying from a gray above and white below through various shades of rusty brown to a uniform shining black colour. The Gray Squirrel (*Sciurus carolinensis*), abundant in the United States, is about 22 inches long, including the tail, and is gray above and white below, washed with brown on the sides and back. This species is very destructive to the maize crops, sometimes collecting in large troops in the north-west and migrating eastwards over rivers and mountains, committing great devastation in the fields in their course. They are often domesticated in the public parks of the northern cities, where they drive away the birds by destroying their eggs and young.

The FLYING SQUIRRELS (Pteromys and Sciuropterus) and GROUND SQUIRRELS (Tamias) are separately noticed.

SQUIRREL MONKEY (*Callithrix sciurea*) is a species of monkey belonging to the family Pitheciidæ (Sakis). The squirrel monkey is one of the prettiest, the most amiable, and most intelligent of the whole tribe of monkeys. The length of its head and body is only about 10 inches; its tail, which is not prehensile, measures 13½ inches; its general colour is olive-gray, with arms and legs reddish or orange-coloured; and the face is bare and whitish, with the nose black. Its eyes are large, soft, and lustrous, giving the little creature an expression of intelligence, heightened by the form of its human-like head, in which the skull is of very large size as compared with the facial bones. The skull, with its inclosed brain, is in fact larger in proportion to the size of the animal than that of any other monkey, so that if we may take the mere size of the brain as a measure of intelligence, we may easily account for the superiority of this interesting little creature.

The squirrel monkey lives in the forests of Guiana and Brazil, feeding principally on fruits and insects. Its tail is of little use to it in its arboreal gambols, but it appears to employ it in keeping itself warm by winding it round its body. In captivity it is gentle and affectionate, and one of the most interesting of the monkey tribe. Humboldt gave some most interesting details with regard to individuals in his possession. When he spoke to them for some time they listened with the most marked attention, but soon raised their hands to his lips, as if to catch the words as they escaped. They recognized the objects represented in engravings, even when not coloured, and when the figures of insects and fruits were shown to them they stretched out their hands towards them, and endeavoured to seize their simulated food.

The squirrel monkey is figured in Plate II., PRIMATES, vol. xi. of this work.

SQUIRTING CUCUMBER. See ELATERIUM.

S'RAD'DHA (Sansk. *s'râddha*, belief), the funeral ceremony of the Hindus, in which balls of food and a supply of water are offered to the deceased ancestors of the sacrificer, or to the *pitr'is* or ancestral spirits collectively. There are several kinds of *s'râddhas:* (1) those which are offered daily, or on the eighth lunation of the month; (2) occasional s'râddhas, as those on the birth of a son, to implore the protection of his ancestors; and (3) the voluntary s'râddhas, which are dictated by some accession of peculiar religious feeling.

SS, COLLAR OF, in heraldry, the *silver* badge of an esquire, or the *golden* badge of a knight. It is also employed, with varieties in the design, to distinguish certain high officials. It derives its name from the curved formation of its links. It is generally reputed to have been introduced into England about 1407, as the cognizance of the house of Lancaster, but according to some authorities there are earlier instances of its use.

STA'BAT MA'TER, a famous mediæval *sequentia* or Latin hymn on the crucifixion, which is so named from its initial words, "Stabat mater dolorosa." It is included in the Passion Week service of the Roman Catholic Church, and has been set to music by several great composers, especially by Palestrina, Steffani, Pergolesi, Haydn, Astorga, Rossini, and Dvorák. See SEQUENTIA.

STABLE and **UNSTABLE; STABILITY.** A system is said to be stable when a slight disturbance of its actual condition would not produce a continually increasing effect, but one which finally ceases to increase, diminishes, becomes an effect of a contrary character, and so on, in an oscillatory manner. The ordinary vibration of a pendulum is an instance; the oscillation takes place about a stable position of equilibrium. We can give no instance of an unstable position; for, by definition, such a thing is a mathematical fiction. Any disturbance, however slight, produces upon an unstable system an effect which continually increases; no unstable equilibrium therefore can exist a moment, for no system made by human hands can be placed with mathematical exactness in a given position. The pendulum of which we have just been speaking has a position of equilibrium exactly opposite to that about which it can oscillate, but no nicety of adjustment will retain it in that position: it may appear to rest for a moment, but will almost instantly begin to fall.

When a system is supported on three or more points, it is well known that there is no equilibrium unless the vertical passing through the centre of gravity cuts the polygon formed by joining these points. This must not be confounded, as is sometimes done, with a case of distinction between stable and unstable equilibrium, for it is a case of equilibrium or no equilibrium, according as the central vertical cuts or does not cut the base of the figure.

Neither must the effects of friction or other resistances be confounded with those of a stable or unstable disposition. A ladder resting upon horizontal ground and against a vertical wall is maintained by friction; were it not for friction there would not be rest in any position; and as it is, the angle which the ladder makes with the ground must not be too small, or it will fall, as most people in the habit of consulting large libraries know to their cost. There is thus a set of positions, from the vertical one to a certain inclination, depending on the amount of friction, in all of which there is equilibrium; while in every other position

there is no equilibrium. Again, when a bar rests on two inclined planes, without friction, there is a position of equilibrium which is really unstable: any displacement would throw the bar against one of the planes without any restoration.

STACCA'TO (Ital., detached), in music, a term employed to denote that certain passages are to be played in a short abrupt manner. A certain amount of time is, in reality, deducted from the true value of each note, and a rest substituted. A dot over a note implies that it is to be played staccato; if a slur is also used the staccato must be very slight; if a dash is employed instead of a dot the staccato force must be increased. Thus:—

Staccato.

STA'CHYS is a genus of plants belonging to the order LABIATÆ. The species are very numerous, about 160 being described, widely distributed, but most abundant in the north temperate regions. They are herbs or rarely shrubs, with the flowers in whorls of two or more, usually in terminal racemes. The calyx is somewhat bell-shaped, with five nearly equal teeth; the corolla has the upper lip erect, arched, and entire, the lower lip longer and spreading, three-lobed, the lateral lobes being bent down; the stamens are four, the two lower the longest; the nuts are smooth, rounded at the top.

Stachys Betonica (common betony) is plentiful in England and the south of Scotland in woods, thickets, &c., but very rare in Ireland; it is widely distributed over Europe, Northern Asia, and North Africa. It was formerly much used in medicine, and is even now a popular remedy for some complaints. When taken fresh it is said to possess intoxicating properties. The leaves have a rough bitter taste, and are slightly aromatic. The roots are nauseous and very bitter, and act as purgatives and emetics. It is a perennial downy or hairy herb, from 1 to 2 feet high, with the leaves nearly all radical, large, oblong, heart-shaped at the base, and coarsely toothed, and purplish-red flowers in several whorls, forming a close, terminal, oblong spike. *Stachys lanata* (woolly woundwort) is a native of Europe, in the neighbourhood of the Mediterranean. This plant and *Stachys Germanica* (German woundwort) are remarkable for their woolly covering, on which account they have been introduced into our gardens; the latter is (very rarely) found in some limestone districts in England apparently wild, but is not a true native. *Stachys sylvatica* (hedge woundwort) grows in ditches and shady places all over Britain, and is a coarse hairy perennial with a disagreeable smell when bruised; it has a stout erect stem, 2 to 4 feet high, ovate, heart-shaped, stalked leaves, and purplish flowers in whorls of six to ten, forming long terminal spikes. *Stachys palustris* (marsh woundwort or clown's all-heal) has pale purple flowers, with the lower lip of the corolla variegated. This plant is a native of Europe, Northern Asia, and North America. It is abundant in watery places, by river banks, &c., in Great Britain. It is called "clown's all-heal" by Gerard. The young shoots and the roots also, when cooked, form an excellent esculent. On the farm it is a weed that should be well looked after, as it exhausts the soil and increases very rapidly. *Stachys arvensis* (field woundwort) is a small slender annual found in fields and waste places in England, but rare in Scotland and Ireland, with small pale purple flowers in whorls, forming loose spikes.

STACHYTAR'PHA is a genus of plants belonging to the order VERBENACEÆ, differing from the genus Verbena in having a two-celled fruit, splitting into two seed-like nutlets, and in having the two upper stamens sterile. The species are natives of South America and the West Indies. They are aromatic herbs or shrubs, and generally handsome plants. *Stachytarpha Jamaicensis* (Jamaica bastard vervain) is a native of the West India Islands, and has there a reputation for remarkable medicinal virtues, something like that which once distinguished our common vervain. Its leaves are sometimes used in the adulteration of tea.

STACK'HOUSIE'Æ is an order of plants belonging to the group POLYPETALÆ, containing only the single genus Stackhousia, embracing about 20 species, all Australian, except one from New Zealand and one from the Philippine Islands. This order is allied to Celastrineæ, but differs in many important respects. The species are small herbs with a perennial, usually woody, root-stock, giving off simple or little branched slender stems. The leaves are alternate, fleshy or leathery, narrow and entire. The flowers are white or yellow, regular in terminal spikes or racemes. The calyx is small, hemispherical, five-lobed; the five petals are inserted on the throat of the calyx, more or less combined in a tubular corolla; there is a thin disc clothing the base of the calyx tube, on the edge of which the five stamens are inserted, having slender filaments, the alternate shorter, and oblong anthers, dehiscing longitudinally; the ovary is sessile, free, two to five lobed, with as many styles and cells, and a solitary ovule in each cell. The fruit consists of two to five globose indehiscent cocci.

STA'DÉ, an ancient town of Germany in Hanover. It is situated 22 miles west by north from the city of Hamburg, in a marshy country, on the banks of the Schwinge, which is navigable to the town at high water, and falls into the Elbe about 3 miles below it. Stadé was formerly strongly fortified, but the works were blown up at the end of the eighteenth century. The town, with the suburbs, contains about 9000 inhabitants, who manufacture flannel, worsted stockings, hats, and lace.

At the village of Brunshausen, where the Schwinge falls into the Elbe, a guard-ship was formerly stationed for the purpose of collecting the duties levied by the Hanoverian government on vessels or merchandise passing up or down the Elbe. The *Stadé Duties* or *Brunshausen Tolls*, as they were then called, were originally regulated by a treaty in 1691, and produced about £40,000 a year. They were abolished in 1861—Great Britain, Hamburg, and other European states paying to Hanover as compensation a sum equivalent to £30,000 per annum for a certain number of years. The amount paid by Great Britain (one-third of the whole) was £160,000.

STA'DIUM, the principal Greek measure of length, was equal to 600 Greek feet or 625 Roman feet, that is, to 606 feet 9 inches English. The Roman mile contained 8 stadia. The Roman writers often measure by stadia, chiefly in geographical and astronomical measurements.

The standard length of this measure was the distance between the pillars at the two ends of the foot-race course at Olympia, which was itself called *stadium*, from its length, and this standard prevailed throughout Greece. Some writers have attempted to show that there were other stadia in use in Greece besides the Olympic.

The common Greek method of reckoning distances, both by sea and land, was by computation, not by measurement. A journey or voyage took a certain number of days, and this number was reduced to stadia by allowing a certain number of stadia to each day's journey. The number of stadia so allowed was computed on the supposition that circumstances were favourable to the traveller's progress; and therefore every impediment, such as wind, tide, currents, windings of the coast, a heavily laden or badly sailing ship, or any deviation from the shortest track by sea, and the corresponding hindrances by land, would tend to increase the number of days which the journey took, and consequently the number of stadia which the distance was computed to contain. These circumstances, together with the fact that the Greek writers are by no means

agreed as to the number of stadia contained in a day's journey, and other sources of inaccuracy which we know to have existed, furnish a satisfactory explanation of the discrepancies which we find in their statements of distances, both when compared with one another and when compared with the actual fact, without there being any occasion to resort to the supposition of a stade different from the Olympic.

When we come, however, to writers as late as the third century of the Christian era, we do find stadia of different lengths. Of these the chief are those of 7 and 7½ to the Roman mile.

The following table represents the varieties of the Greek stadium, as usually fixed by archæologists:—

	Yds.	Ft.	Inches.
Stade assigned to Aristotle's measurement of the earth's surface, . . .	109	1	2·26992
Mean geographical stade, ...	168	1	6
Olympic stade, ...	202	0	9
Stade of 7½ to the Roman mile, . .	215	2	2·4
Stade of 7 to the Roman mile, . . .	231	0	5·121

The racecourse for foot races at Olympia was called stadium, as above mentioned, and the same name was applied to all other such courses. There still exist considerable ruins of stadia; among the most remarkable of which are those at Delphi, Athens, Messênê, Ephesos, and Laodikeia.

STADT'HOLDER (*Statthalter* in German, *Stadhouder* in Dutch) means lieutenant or governor. The appellation Statthalter is used in the cantons of German Switzerland to denote the civil officer who is next to the landamman or chief magistrate. In the federal republic of the Seven United Provinces of the Netherlands the stadhouder was himself the first magistrate or president of the Union. When several of the towns of Holland revolted in 1572 against the tyranny of the Duke of Alva, the lieutenant of King Philip of Spain, they chose for their governor William the Silent, prince of Orange, swearing allegiance to him as the king's stadhouder. But it was not until after the death of William, in 1584, that the three united provinces of Holland, Zealand, and Utrecht agreed to have one stadhouder in common, and appointed to that office Maurice of Nassau, son of the deceased William, in 1587. From that time it remained hereditary in the house of Nassau till the death of William III., who was William III. of England as well as of Holland, in 1702, when it became vacant. But in 1747, after a struggle between the republican and the Orange parties, the latter proclaimed William IV. hereditary stadhouder of the Seven United Provinces. His son William V. was expelled by the French in 1795, and resigned the stadhoudership by treaty with France in 1802, since which time the office has not been revived, the republic of the Netherlands having been transformed into a kingdom in 1814.

STAEL, MADAME DE (Anne Louise Germaine Necker), born at Paris, 22nd April, 1766, was the only child of M. Necker, minister of finance to Louis XVI. She applied herself to literature at an early age. In 1788 she published "Lettres sur les Ouvrages et le Caractère de J. J. Rousseau." About this time she was married to the Baron de Staël-Holstein, the Swedish ambassador at Paris, who was much older than herself. When the French Revolution broke out, and her parents had retired to Switzerland, the baron's diplomatic character was a protection to his household, and Madame de Staël remained at Paris through the first storms of that period. Her imagination was at first captivated by the prospects of a revolution which promised the reform of abuses, but her generous nature soon shrank from its atrocities. She even ventured to publish a defence of the Queen Marie Antoinette, then upon her trial: "Réflexions sur le Procès de la Reine" (August, 1793). But the triumph of the Terrorists drove her at last out of Paris. After their fall she returned, and became the leader of a distinguished circle of literary men and politicians. After the establishment of the military dictatorship of Bonaparte, whom she seems to have disliked from the first, her salon became the opposition club of the time. She was supposed to have encouraged her father to publish his last work, "Dernières Vues de Politique et de Finance," in which he declaimed against the government of a single man; the work was forbidden in France, and Bonaparte, then first consul, sent Madame de Staël an order to quit Paris. She removed to Switzerland, and then travelled through Italy, where she gathered materials for her "Corinne." This appeared in 1807, and immediately obtained a European reputation. It is the most impassioned and poetical of all her works, and may be described as an ideal glorification of Italy. There are several English translations. Madame de Staël had already published a novel in 1803, entitled "Delphine." She next proceeded to Germany, and gathered the materials for her work "De l'Allemagne," in which she has described the feelings, the literature, and the habits of the German people with great truth, insight, and impartiality. This work was printed at Paris in 1810. The MS. was submitted to the censors, according to the existing laws, and after several passages had been expunged the publication was authorized; 10,000 copies were struck off, when suddenly the whole stock was seized at the publisher's by Napoleon's minister of police and suppressed. Madame de Staël, who was staying at Blois, retired to Coppet, in Switzerland, where she remonstrated without effect against this arbitrary proceeding. The work was first published at London in 1813.

She remained for a time at Coppet, closely watched, even on Swiss ground, by the French police. At last she contrived to escape from thraldom, and visited Russia on her way to England. She has given an account of her wanderings and the petty persecution to which she was subject, in her "Dix Années d'Exil." In 1814, after Napoleon's abdication, she returned to Paris, where she, with Benjamin Constant and other old friends, inspired what was called the constitutional party. After the emperor's return from Elba, Madame de Staël, as well as Benjamin Constant, appeared reconciled to his government, thinking that he must now accommodate himself to a constitutional system. When Louis XVIII. was again restored she returned to Switzerland, and seemed to have weaned herself from active politics. She occupied herself with preparing her last work for the press, "Considérations sur la Révolution Française," published after her death, which took place 14th July, 1817. Her will made known as a fact, what had previously been suspected, her private second marriage, in 1812, when she was forty-six years old, to M. de Rocca, a young French cavalry officer, with whom she had lived very happily, and who survived her but a few months. Madame de Staël is by no means attractive as a personage. Her utter disregard of "les convenances" in every way; her egregious vanity, which lasted after she was quite an old woman, and which was the more ridiculous since she never at any time had any real claim to good looks; her folly and conceit, and the viciousness of her literary style, annoy the reader of her biography and of her works. But at the same time she wielded immense influence over France, and on the whole for good. She was the first to widen the horizon of the intensely national and narrow French mind by her Italian and German works, and, indeed, to clear the way for nineteenth-century notions. The prestige she gave to woman as an intellectual force was also a great boon.

STAFF COLLEGE, founded 1858, is an institution established by the government in connection with the military college at Sandhurst, near which it is situated, for the

object of giving superior instruction to officers who may be candidates for the general staff, the number at present, according to the revised regulations issued in 1874, being limited to forty. Admission is obtained by competitive examination, to be qualified to participate in which an officer must have been five years in active service, have passed the qualifying examination for a captaincy, and must have obtained certain rather stringent certificates and recommendations from his commanding and senior officers. Successful candidates, while at the college, receive their regular pay as in active service, and the whole cost of the establishment, with the exception of mess subscriptions (about £8000 per annum), is paid by the government. The students remain two years, and at the end of that period an examination takes place, which decides the candidate's appointment.

STAFF, MILITARY. In the British army this consists of those general, field, and regimental officers to whom is confided the care of providing the means of rendering the military force of the nation efficient, and regulating the duties in every branch of the service.

Besides the commander-in-chief, his military secretaries and aids-de-camp, the general staff consists of the adjutant-general and quartermaster-general, with their respective deputies, assistants, and deputy-assistants; the director-general of the medical department, and chaplain-general of the forces. The staff of the ordnance department consists of the master-general and lieutenant-general, with their deputies and assistants; the inspector of fortifications, and the director of the engineers. The headquarters for the general staff are in London. There are also, for the several military districts into which Great Britain and Ireland are divided, inspecting field-officers, assistant adjutants-general, and majors of brigade, together with the officers attached to the recruiting service. Lastly, in India there is a staff graduated in accordance with the general staff of the army.

The adjutant-general of the army is charged with the duty of recruiting, clothing, and arming the troops, superintending their discipline, granting leave of absence, and discharging the men when the period of their service is expired. To the quartermaster-general is confided the duty of regulating the marches of the troops, providing the supplies of provisions, and assigning the quarters or places of encampment.

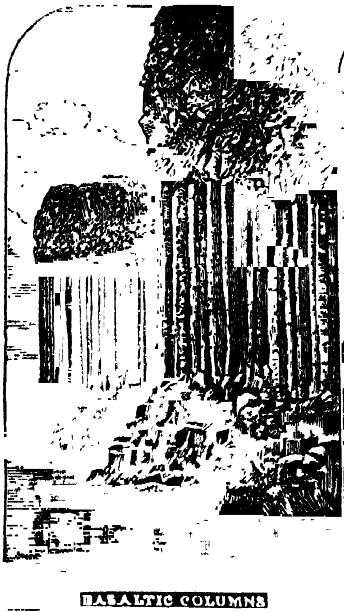
The staff of a regiment in the British army consists of the adjutant, quartermaster, paymaster, chaplain, and surgeon.

About the year 1800 the British government first formed a particular school for the purpose of instructing officers in the art of surveying ground in connection with that part of tactics which relates to the choice of routes and of advantageous positions for troops. These officers were first employed in Egypt, where they rendered considerable service; and the school was afterwards united to the Royal Military College, which had been then recently instituted for the instruction of cadets who were to serve in the cavalry or the infantry of the line. [See STAFF COLLEGE.] The duties of officers belonging to the quartermaster-general's staff are explained under RECONNAISSANCE.

The military force in India forms an almost independent command, under a commander-in-chief, whose headquarters are in Bengal, with subordinate commanders-in-chief in Bombay and Madras, and in each presidency there are several military divisions.

STAFF or STAVE, in music, the name given to the five parallel lines and intermediate spaces on which the notes or characters are placed by which we indicate certain musical sounds. See NOTATION OF MUSIC.

STAFF'A. This small but well-known island, lying 7 miles west of the island of Mull, on the western coast of Scotland, is of oval shape, about 1½ mile in circumference, and is entirely composed of amorphous and pillared BASALT.



BASALTIC COLUMNS

CLAMSHELL CAVE

FINGAL'S CAVE

The pillars have in many parts of the rugged shore yielded to the action of the sea, and permitted the formation of caves, some of them uncommonly picturesque, which are generally arched over by what seems to be amorphous trap rock, but really is often prismatized in an irregular manner.

The section of the pillars is rarely triangular or quadrangular, but generally pentagonal or hexagonal. Some of

them are 2 feet in diameter; others are as small as 1 foot, 9 inches, or even 6 inches. They are less regularly jointed than those of the Giant's Causeway, on the north coast of Ireland. In position they are sometimes erect, sometimes oblique, and not unfrequently horizontal; they are also often curved. See Plate BASALT—FINGAL'S CAVE, vol. ii.

The largest of the caves is Fingal's, which may be entered on foot on the south side, along a rugged pavement of columnar summits. The roof is formed partly of pillar sections and partly of the already-mentioned amorphous trap; the sides are straight vertical prisms of basalt, washed at their base by a deep and often tumultuous sea. The entire length is 230 feet; the greatest breadth is 53 feet; the height of the arch at the mouth is 66 feet, with an entablature of 30 feet; depth of water at the bottom, 9 feet. In moderate weather boats sail up to its furthest extremity. There are several other caves along the coast of the island, of which the most noteworthy is called Clamshell Cave, from the peculiar curve in which the basaltic columns recline, giving it somewhat the appearance of a pecten shell. It is 30 feet in height, from 16 to 18 feet broad, and 130 feet long, its lateral dimensions gradually contracting as it recedes from the opening.

The island of Staffa is uninhabited, but is frequently visited during the summer, when steamers ply at frequent intervals from Oban.

STAFFORD, a midland county of England, bounded N.E. by Derbyshire, E. by Leicestershire, S.E. by Warwickshire, S. by Worcestershire, S.W. and W. by Shropshire, and N.W. by Cheshire. The greatest length, north to south, is 60 miles; the greatest breadth, east to west, is 38 miles. A portion of Worcestershire, including the town of Dudley, is entirely insulated by Staffordshire, and a detached portion of the latter county is surrounded by Worcestershire. The area is 732,434 acres. The population in 1881 was 981,385.

Surface and Geology.—The northern is the highest part of the county. It consists chiefly of wild moorlands, formed by long ridges extending from north-west to south-east, separated from each other by deep dells or by valleys watered by the tributaries of the Trent, and gradually subsiding towards the banks of that river. The highest summits have an elevation of about 1200 feet above the sea. With the exception of the valleys the whole of the district is sterile, cold, and dreary. On the eastern side of the county are the high grounds of Needwood Forest; and south of the Trent, towards the centre—that is, between Stafford and Lichfield—rise those of Cannock Chase. On the south-east border, between Dudley and Hales Owen, lie the Rowley Hills, which reach an elevation of 900 feet.

The western districts are occupied by a tract of high ground, which separates the streams flowing westward by the Severn into the Atlantic from those flowing eastward by the Trent and the Humber into the North Sea. Ashley Heath, in this neighbourhood, has an elevation of 800 feet.

The lowest spots in the county are near the bank of the Severn, at the south-western extremity, and the bank of the Trent, at the junction of the Dove, on the eastern border. These are 60 feet and 100 feet respectively above the level of the Thames at Brentford.

Nearly the whole of Staffordshire is included in the great red marl or new red sandstone district of Central England. The northern part is indeed beyond the limit of this formation; and there are some insulated districts occupied by the coal measures or other subjacent formations, which rise through the red marl. The higher grounds of Needwood Forest and Cannock Chase, as well as those which separate the basin of the Trent from that of the Severn, consist of red marl. Gypsum is quarried in Needwood Forest and in the adjacent part of the valley of the Dove. The pure white gypsum, or that slightly streaked with red, yields plaster of Paris, which is much used in the Potteries for moulds.

The Dudley or South Staffordshire coal-field extends from Cannock Chase to the Worcestershire border near Stourbridge, about 20 miles in length north by east to south by west; and from Kingswinford to Soho, near Birmingham, 10 miles west to east. These dimensions indeed include not only the coal-field itself, but the Rowley Hills, composed of transition and other rocks, by which it is intersected. The coal measures rest immediately on a transition stratum. The hills south-east of Dudley consist of one mass of basalt and amygdaloid, round which the coal measures do not crop out, but preserve their usual level in approaching it. The basalt, which is very pure, is locally termed Rowley Rag. It has been quarried for mending the roads and paving the streets of Birmingham. Trap rock is found in that district of the coal-field lying near Walsall; it is apparently part of a thick vertical greenstone dyke. The coal of the southern portions of the Dudley field is distinguished by the occurrence of an extensive bed, called the Main-coal, 30 feet thick. It really consists of thirteen distinct seams, but they are so close together as to form almost a single stratum. In the northern part of the field seams of coal are found 4, 6, and 8 feet thick, which appear to be subjacent to the main coal.

In the north of the shire occurs another coal-field ("the Pottery") of triangular form. It extends from Longton in the Potteries to Congleton in Cheshire, where is the apex of the triangle, and is 13 miles in length from south by east to north by west. Its greatest breadth, which is in the southern part, forming the base of the triangle, is 8 or 10 miles. A short distance to the east of this lies the Cheadle coal-field, the town of Cheadle being situated near its south-west border. It appears to be an isolated basin, the strata dipping towards Cheadle as a centre, and resting upon millstone grit.

A prolongation of the South Lancashire coal-field extends into the northern part of the county about Flash, where several mines are worked. The Warwickshire coal-field just touches the border near Tamworth. The county also possesses rich and abundant iron ores. In addition to the immense quantities of coal and iron obtained in various parts, copper, lead, sandstone, marble, alabaster, and the best pottery clay are important mineral products. As the result of important borings in 1874–75 it was discovered that coal was obtainable at workable depths from districts previously considered beyond the boundaries of the Staffordshire coal basins.

Rivers, &c.—The county belongs almost entirely to the basin of the Humber. The Trent, the most important tributary of that estuary, rises from three springs on the north-west border, near Knypersley Hall, and runs south through the Potteries 12 miles to Trentham Park. Thence it flows 18 miles south-east by Stone and Rugeley, being joined above the latter town by the river Sowe. From Rugeley the Trent bends east 10 miles to the junction of the Tame and the Mease, and then turning north-east runs 8 miles to Burton, where it becomes navigable; 2 or 3 miles below Burton it quits Staffordshire altogether. Its whole length in the county or upon its border is about 50 miles.

The principal tributaries of the Trent are the Lyme from Newcastle-under-Lyme, the Sowe, the Blythe, the Tame, the Mease, and the Dove. The western districts belong to the basin of the Severn, which flows for 2 miles across the south-west corner. About 14 miles of the course of the Stour lie on or within the south of Staffordshire, to which its tributary, the Smestow, which rises near Wolverhampton, wholly belongs.

The canals are numerous, the most important being the

Trent and Mersey, or, as it is sometimes called, the Grand Trunk Canal, which, commencing in the Trent at its junction with the Derwent in Derbyshire, enters the county near the confluence of the Dove, and follows the valley of the Trent through its centre to Stoke, in the Potteries, whence it continues to the Mersey, at Runcorn Gap. About 50 miles of its course belong to Staffordshire. It passes near Burton-upon-Trent, where there is a cut to the Trent, Rugeley, Stone, Stoke, Hanley, Burslem, and Tunstall. The Birmingham and the Birmingham and Liverpool Junction canals may be regarded as forming another important line, entering the shire near Birmingham, and traversing the iron and coal district, by Dudley and Wolverhampton, and then running north-west into Shropshire. The length of this line may be estimated at about 32 miles. These two main trunks of canal navigation belong to the county at large. There are several smaller lines which supply only the coal and iron districts of the south.

Staffordshire is provided with ample railway facilities. The Great Western, the Midland, and London and North-Western run through its centre; the North Staffordshire line passes through the Pottery district; and branches extend to all the principal towns.

Agriculture.—The air is sharp in comparison with that of the country lying south of it, while, at the same time, it is more subject to continued rains, which make the crops later and the harvests more precarious. The quantity of rain falling during the year is, on an average, about 36 inches. From this it is apparent that the heavy soils, and those which are situated on impervious subsoils, require very complete draining before they can be made productive, whatever may be the natural fertility of the surface. The western parts of England are in general more rainy than the eastern, and in this respect Staffordshire does not differ from the neighbouring districts. One cause of this extraordinary humidity may be found in the high lands which traverse it, and arrest the vapours blowing from the Atlantic. The middle and southern portions are comparatively flat, and have only gently undulating hills. Here the most fertile lands are situated, and those farms which are in the best state of cultivation. The farmers are intelligent, and examples of every system of husbandry are followed. Drainage is extensively practised, and the most recent improvements in agriculture are very widely adopted. The county is, of course, more of a mining and manufacturing than an agricultural one. Two-fifths of the arable land consist of clays and sandy loams, two-fifths of gravelly and sandy loams, and one-fifth of light gravel and sand, chiefly good turnip land. Rich meadows spread along the banks of most of the streams—the valley of the Trent being particularly fertile and beautiful. Dairy husbandry is extensively practised, and the cheese produced is little inferior to that of Cheshire and Derby. Many fine beasts are also fattened in stalls. The original Staffordshire sheep has either been superseded by more useful breeds, or changed and improved by crossing. Every kind which enjoys any repute is now found here. The farm horses are active and strong, and in general well kept. The Staffordshire hog of the old breed is coarser than the Berkshire or Essex, but much pains have been taken to introduce better pigs, and with considerable success.

Manufactures.—Its subterranean treasures have so stimulated manufacture in Staffordshire that it has now the largest average population in Great Britain after Middlesex and Lancashire. The county is particularly famous for its potteries and iron-works. The chief seat of the former is in a district denominated the Potteries, between Newcastle-under-Lyme and Norton-on-the-Moors, in which there are several very considerable towns—including Stoke, Longton, Burslem, and Hanley—and villages mostly supported by the business. The neighbourhood affords abundance of good clay and coal; but the finest clays are mostly brought from Purbeck, in Dorsetshire; soapstone from Cornwall; and flints from the chalk pits near Gravesend, and from Wales and Ireland. The iron-works are principally situated in the south angle of the county, in the vicinity of Walsall, Wednesbury, and Bilston. The manufacture of locks, nails, edge tools, bridles, spurs, and an infinite variety of other hardware articles, is prosecuted upon a very large scale at Wolverhampton, Bilston, West Bromwich, Willenhall, Walsall, and their vicinity. The South Staffordshire coal-field is popularly known by the name of the Black Country, from the smoke created by the factories and works seen in all directions. At Soho, near Smethwick, is the famous establishment of Messrs. Boulton & Watt, for the manufacture of steam-engines; glass is manufactured at Smethwick, West Bromwich, and Kingswinford; bricks and tiles in both North and South Staffordshire; salt near Stafford; boots and shoes at Stafford and Stone; silk at Leek; and there are cotton mills in various parts of the county. Burton-on-Trent is noted over the world for its breweries, of which there are thirty in the town (including the eminent firms of Bass and Allsopp), employing 17,000 hands in the brewing of something like 3,000,000 barrels of beer annually.

Staffordshire is divided into five hundreds. It lies in the diocese of Lichfield and archdeaconries of Stafford and Stoke. It is included in the Oxford circuit, and the assizes are held at Stafford. For parliamentary purposes it is divided into seven divisions, each division returning one member. Wolverhampton returns three members, and the following boroughs one member each, making seventeen representatives for the entire county:—Stafford, Stoke-upon-Trent, Hanley, Newcastle-under-Lyme, Walsall, Wednesbury, and West Bromwich.

History, Antiquities, &c.—Previous to the Roman period Staffordshire appears to have formed part of the territories of the Cornavii, or Carnabii. Under the Romans it was comprehended in the province of Flavia Cæsariensis. The ancient roads, Watling Street, Ryknild Street, and Via Devana crossed the county.

There are traces of camps or other military works supposed to be of Roman origin at four or five places, and Roman antiquities have been discovered in various localities, especially a large quantity of silver coins at Rowley Regis. Tumuli, some of which are thought to be Roman, are scattered over the whole of the shire.

On the conquest of South Britain by the Saxons, the county was comprised in the kingdom of Mercia, or of the Middle Angles. In the division of the island between the Saxons and Danes, in the time of Alfred, it was partly included in the Danelagh or Danish territory, the Watling Street being the boundary; but the whole was recovered by the later Saxon kings.

In the Wars of the Roses, the Earl of Salisbury, marching from the north towards London, in 1459, with 5000 men, was intercepted at Blore Heath, on the western side of the county, between Drayton and Eccleshall, by 10,000 Lancastrians under Lord Audley. The good generalship of Salisbury secured the victory. Lord Audley was killed, with all his chief officers and a fourth part of his army. A stone pedestal, surmounted by an ancient wooden cross, marks the field of battle. Richard III. was with his army at Tamworth just before the battle of Bosworth Field in 1485.

The principal monuments of the middle ages are ecclesiastical. Lichfield Cathedral is the most important. Croxdon Abbey, between Cheadle and Uttoxeter, is a fine ruin, in a narrow valley watered by a small rivulet.

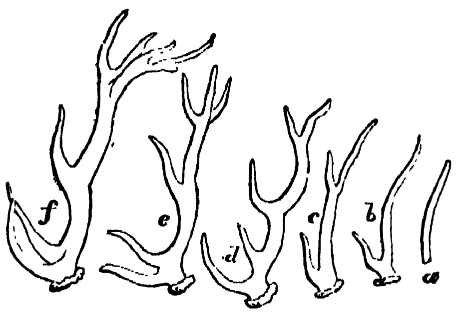
Mary Queen of Scots was imprisoned for some months under the care of the Earl of Shrewsbury, at Tutbury Castle. In the civil war of Charles I. Staffordshire generally embraced the side of the Parliament. Some Royalists, under the command of the Earl of Chesterfield,

garrisoned Lichfield Cathedral and Close; but it was captured by the Parliamentarians, though with the loss of their general, Lord Brooke (March, 1643). This post was retaken about a month after by Prince Rupert. The Parliamentarians occupied Stafford and Wolverhampton, and subsequently captured Eccleshall Castle, and took and demolished Stafford Castle; they also besieged Tutbury, but without success. In 1645 Charles I. marched through Staffordshire before the battle of Naseby, and after his defeat retired within its borders. He appears to have had at this time two garrisons in the county, Lichfield Close and Tutbury. Dudley Castle, in the insulated portion of Worcestershire, was also held by his adherents; but within a year all the Royalist strongholds surrendered. In the rebellion of 1745 the Pretender's army lay at Leek, while that of the Duke of Cumberland occupied Stone.

STAFFORD, the county town, and a municipal and parliamentary borough, of the above county, is 133½ miles N.W. from London, and 25 miles N.N.W. of Birmingham, by the North-western Railway. It is situated on the north bank of the Sowe, and consists chiefly of two principal streets, which are prolonged into suburbs on the north and south. The houses are generally of brick, well built, and the streets are paved and neatly laid out. There are also some very pretty modern suburban villas in the outskirts. The town is very ancient, and was formerly walled, but the walls were demolished by Cromwell's parliamentary army. The castle, about 1½ mile south-west, has been partly rebuilt in recent times. There are a spacious county hall, gaol, free library, infirmary, lunatic asylum, borough hall, market hall, two ancient parish churches, several other churches, and places of worship for dissenters. There are also a grammar-school and several benevolent institutions, including one for the relief of the widows and orphans of the clergy in the archdeaconry of Stafford, which is supported by subscriptions and funded property. In 1873 Mrs. W. Salt presented to the town the fine library and archæological collection of her late husband, and in 1874 they were transferred to elegant and commodious buildings, given for the purposes by T. Salt, Esq., M.P. The chief branches of trade are shoemaking and tanning. The town is also noted for the excellence of its ale. The municipal borough is governed by ten aldermen (of whom one is mayor) and twenty-four councillors. The parliamentary borough returns one member. The population of the municipal borough in 1881 was 19,977. Stafford was the birthplace of Isaak Walton. It was founded by Ethelfleda, the sister of Edmund the Elder, and is described at some length in Domesday Book.

STAFF-TREE (Celastrus) is a genus of plants belonging to the order CELASTRINEÆ. The species are small unarmed climbing shrubs or small trees, found in the temperate regions of tropical countries. The leaves are alternate, entire or serrate, furnished with small stipules. The small green or white flowers are arranged in terminal racemes or panicles, and turn into showy fruits with the seeds enveloped in a large brightly-coloured arillus. The Bitter-sweet or Wax-work of North America (*Celastrus scandens*) is a climbing shrub, sometimes cultivated as an ornamental plant; its fruits are orange-coloured, opening when ripe and disclosing the reddish-brown seeds, which are inclosed in a bright orange or scarlet arillus. The bark is purgative and emetic, and the seeds possess narcotic and stimulating properties. The seeds of *Celastrus paniculatus*, a native of Brazil, yield an oil which is used both medicinally and for burning in lamps.

STAG or **RED DEER** (*Cervus elaphus*) is a species of DEER (Cervidæ), a native of Britain and temperate Europe. The stag stands about 4 feet high at the shoulder. The body is of a general reddish-brown colour, acquiring a grayish tinge in winter. On the rump is a pale patch on either side of the short tail, which is also of a light colour; there is a blackish line along the back; the hair on the neck is long and of a grayish tinge, forming a kind of mane. In the fawn the hide is spotted with white. The antlers of the adult stag are large and rounded. They are only developed in the male, and are shed annually during March or in the beginning of April, and are reproduced by August. From the successive stages of development through which these antlers pass, special terms are applied to the stag in this country. In the spring following its birth the young stag is called a "brocket," from its straight, conical, unbranched antlers (*a* in figure.) In the next spring the antler (*b*) has a small branch near the base, directed forwards and forming the brow-antler, the main stem being known as the beam; the young stag is now called a "spayad." In the third year the beam gives off another branch higher up (*c*), which is the tres. In the "staggard," or four-year-old stag, the whole antler (*d*) has enlarged considerably, the brow-antler bifurcates into the brow and the bez-tyne, and the main beam also divides at the top into two surroyals. In the fifth year, when the animal gets the name of "stag," the antlers (*e*) grow in size, and the surroyals become more numerous. In the following years, as the animal increases in size and weight, the antlers (*f*) also increase in size,



Development of the Horns of the Red Deer.

and the top of the main beam branches out into numerous long and powerful surroyals; the adult stag is known as the "great hart." In fully developed antlers there may be from forty to sixty points, though in this country they are never so numerous.

In England the stag is found wild at the present day only in Exmoor Forest, and there the noble sport of stag-hunting is carried on under the old conditions. In earlier times the pursuit of the stag constituted the noble art of *venerie*, and was eagerly followed by nobles and princes. The passion of William the Conqueror for the chase is recorded in the severe laws which he enacted against those who should kill hart or hind; it was said of him that he "loved the wild deer as though he had been their father." In the Highlands of Scotland and in the forests of Ireland the red deer is still found wild, and in the former country deer-stalking is a favourite sport, though necessarily confined to a few. In some parts of England the sport lingers in a degenerate form.

The red deer is strong, swift, and vigilant, with a very acute sense of smell. In the winter both sexes collect in considerable herds. The pairing season is in the early part of October, and the stags frequently engage in desperate combats for the possession of the hinds. The young are born about the end of May or the beginning of June. The venison is coarser than that of the fallow deer.

STAG-BEETLE (Lucanidæ) is a family of beetles belonging to the group LAMELLICORNIA. The common

name is derived from the powerful mandibles with which the males are provided, projecting in front of the head and furnished with snags like the antlers of deer. The antennæ are bent (geniculate) and pectinated, the lamellæ of the apical joints being immovable. About 550 species of stag-beetles are known, especially abundant in the forests of the tropics. The Common European Stag-beetle (*Lucanus cervus*) Plate I., BEETLES, fig. 6, is the largest of British beetles, measuring 2 inches in length exclusive of the mandibles; the general colour is black, with the wing-cases brownish. The head is wider than the body, and furnished with an enormous pair of projecting, arched, horn-like mandibles, which have three large and several smaller snags or teeth. The females are smaller, and have much shorter mandibles. The stag-beetle lives in woods, hiding in the trunks of trees by day and flying abroad in the night. It is said to seize caterpillars and soft-bodied insects with its powerful mandibles and suck their juices; but it feeds chiefly on the sap exuding from trees, the mandibles being principally used as weapons of offence. The larvæ are large fleshy grubs living in the interior of the trunks of trees, into which they bore very readily; they are furnished with strong jaws, with which they gnaw wood, reducing it to a coarse powder. Two other species of stag-beetles are found in Britain, *Dorcus parallelopipedus* and *Sinodendron cylindricum*, the latter being found in abundance in all stages within dead ash-trees. *Chiasognathus Grantii* (fig. 4, Plate I., BEETLES) is an extraordinary South American stag beetle, having the mandibles elongated and saw-like.

STAGEI'RA (Lat. *Stagira*), a town of Chalkidikê, in Macedon, on the shores of the Strumonic Gulf, made famous by being the birthplace of Aristotle. Hence that philosopher is poetically called the Stageirite or Stagirite.

> "Plato's love sublime,
> And all the wisdom of the Stagirite
> Enriched and beautified his studious mind."
> —*Wordsworth.*

STAG'GERS, a popular name for several forms of horse disease. The most serious of these is the disease termed mad or sleepy staggers, which is caused by inflammation of the brain, and is attended by high fever and violent convulsive struggling, ending in stupor. It is treated by bleeding, the application of cold, and full doses of physic, but it is almost invariably fatal. Grass or stomach staggers is a form of acute indigestion, the result of the stomach having been overloaded with wet grass, vetches, clover, a full meal of wheat, or any indigestible food. It is most common in the autumn, and is indicated by distended abdomen, impaired appetite, dull aspect, and the characteristic gait. It is treated by taking blood from the palate, by the administration of full doses of purgative medicine, clysters, and warm applications to the belly. When the dulness continues to increase the free administration of stimulants may be required.

STAG'HOUND is a species of dog, formerly used in the pursuit of the stag. It approaches most nearly the old English or southern hound, being derived from that breed by a cross with the foxhound. The staghound is a tall, strongly built, well-formed dog, noted for its energy, power, perseverance, and comparative swiftness in the chase. In disposition it is affectionate, mild, and gentle. The sport of stag-hunting is not now much practised in Britain. It was a favourite pastime with George III. There is still a royal pack, but the old staghound is practically extinct, foxhounds being used instead.

STAINER, JACOB, a famous German violin-maker, was born at Absam, in Tyrol, not far from Innsbrück, in 1621. He began work as a boy with an organ-builder, but soon changed to a lutenist. Then the story goes that he became a skilled workman on the old viols, and travelled about, at last reaching Italy, where he found out the Amati family at Cremona, saw their excellence, worked with them, married a daughter of the family, and returned to Germany with the new and precious secret of the true Italian Cremona fiddle. For all this there is absolutely not a shadow of evidence. The probability is that Stainer was never in Italy at all, but worked industriously in Tyrol for the court of the Archduke Ferdinand Charles, at Innsbrück, and finding there some of the new Cremona models, had the wit to perceive the secrets of their excellence. In 1645 he married a Tyrolese maiden, Margarethe Holzhammer. Stainer worked steadily on at his little village till he went mad, about the year 1680, and the wooden bench to which the poor fellow was chained is still shown. In 1683 he was released by death.

Stainer was a true enthusiast, devoting his life to his beloved art. In his walks he carried a hammer with him with which he struck the pine trees marked for felling to try and discover sonorous wood; buying a little when he met with his fancy—probably a mere fanciful error, but indicative of the care of the man. He was always miserably poor, and had sometimes to make instruments just as fast as he could to get bread, which accounts for the number of inferior, though genuine, Stainer violins in the market. He petitioned the emperor for money in 1677, when his faculties were beginning to fail, but was refused. It is thought that his imprisonment on a charge of heresy, in 1669, was the origin of the wreck of his mind: he was inclined somewhat towards Lutheran doctrines, but made haste to recant them and regain his liberty. He was appointed court violin-maker by the Emperor Leopold I. in that year. Stainer's most influential patrons were the Archduke Ferdinand Charles, a very good friend to him, and the Archbishop of Salzburg.

Stainer was no mere copyist. Although he seized the new Italian ideas on violin making, he used them in his own way. The peculiar flat middle of the belly of a Stainer violin, joined with a rather unusual height, is a well-known feature. The model cannot be compared for beauty to that of Stradivari: and looking at the poor tone of a Stainer (so that no really great player ever performs in public on one), it seems a thousand pities that the tradition was not true, and that Stainer did not really study in Italy. Had he done so his splendid work (that is, if we regard his best instruments) must have produced an effect almost unrivalled. Stainer's tone is sweet and flowing as a rule, but wants intensity and force. And indeed, with all his faults, he is the best, as he was the first, of the German violin-makers.

STAINES, a small town of England, in the county of Middlesex, situated on the left bank of the Thames, 19 miles from London by rail. Its parish church was rebuilt in 1828. It has a racecourse, and some mustard mills and breweries, whence the name; and between the town and the village of Old Windsor is Cooper's Hill Engineering College for students for the Indian Civil Service.

STALAC'TITES (Gr. *stalassein*, to drop) are the limy pendants hanging from the roof of caverns. Water, on percolating through a limestone rock, is enabled to take up a certain amount of calcareous matter by means of the trace of carbonic acid with which it is ordinarily charged, and when such moisture happens to ooze out upon the roof or sides of a subterranean cavity evaporation occurs, and the dissolved material is deposited as a thin film on the exposed surface. The inequalities in the roof usually tend to lead the trickling drops to various defined points, where the lime consequently accumulates more quickly than anywhere else, and thus the stalactitic forms are produced. They may often be studied on a small scale beneath bridges, where the lime in the mortar or cement furnishes the requisite material for their formation. In the

majority of instances in caves, the trickling is so rapid that numerous drops fall to the floor before evaporating, and thus give rise also to a calcareous encrustation there. The latter is known as *stalagmite* (Gr. *stalagma*, a drop), and often exhibits inequalities of thickness and scattered rising bosses, owing to the more frequent dripping at some places than at others. (See Professor Boyd Dawkins' "Cave Hunting.")

STALAG'MITES. See STALACTITES.

STA'LYBRIDGE, a market-town and a municipal borough in Lancashire and Cheshire, 7 miles north-east of Stockport, 8 east of Manchester, and 190 from London by the North-western Railway. Most of the inhabitants are engaged in the cotton manufacture. There are also print-works, iron-foundries, and machine manufactories, and in the neighbourhood are some collieries and brickfields. The town has a good supply of water, and a thorough system of drainage. It was constituted a parliamentary borough by the Reform Act of 1867, returning one member to Parliament, and in 1885 was included in the Hyde division of the county. The population in 1881 was 39,761. The corporation consists of eight aldermen and twenty-five councillors, including the mayor. The town derives its name from the Staveleighs, who formerly resided here.

STA'MENS, in botany, are the organs which constitute the last whorl but one of the series which forms the FLOWER in plants, the pistil with its parts forming the last or innermost whorl. The stamens constitute the male organs of the flower, and are composed in most cases of three parts: (1) the filament, a long slender organ, on the summit of which is placed (2) the anther, which is a two-lobed sac containing (3) the pollen, which is composed of little grains constituting the fructifying influence of the plant.

The stamen in theoretical botany is considered, as well as the other parts of the flower, a modification of the leaf. Although its form, structure, and functions differ so much from the latter, it is not difficult to point out the series of modifications by which the one is converted into the other. In many plants the leaves cannot be distinguished near the flowers from the bracts, and these again cannot be distinguished from the sepals forming the calyx; whilst the calyx often insensibly passes into the corolla, and parts of flowers are often seen possessing both the characters of sepals and petals. In the case of the white water-lily, a good example is offered of the passage of petals into stamens, thus completing the series of changes from leaves to stamens. In this plant a gradual contraction of the inner petals is seen to take place at their upper parts, the cellular tissue becomes coloured, and partakes of the character of pollen-grains, and these changes become more and more decided till the whorl of the stamens is fully established in the centre of the plant.

In their normal position in the flower the first row of stamens is always alternate with the petals; and as these organs are alternate with the sepals, the stamens are opposite the sepals. If there is a second row of stamens, it will be alternate with the first, and thus of course opposite the petals. It, however, frequently happens, as in the primrose, that there is only one row of stamens, and yet opposite the petals. In such cases the anomaly is accounted for by supposing that the first row has not been developed, and consequently the second stand in their original position, that is, alternate with the aborted row. When there are only five petals and ten stamens, as in Silene, the latter are supposed to form a double row.

The stamens are said to arise from various parts of the flower, and according to the part of the flower from which they arise, terms have been applied to express this origin, which are of great importance in systematic botany. When the stamens arise from (or, as it is often expressed, are inserted into) the calyx or corolla, they are said to be *perigynous;* when they arise from under the pistil or ovary, *hypogynous;* when from the pistil itself, *epigynous.* The classes and subclasses of the natural system are subdivided according to the existence of these distinctions in the families of plants. The above terms, however, must not be supposed to express the fact that the stamens do really originate in the parts from which they are said to arise or to be inserted. The fact is, the stamens always arise from a point in the axis of the flower between the petals and ovary; and when attached to these or other parts it must only be looked upon as an adhesion of one organ to another. Thus, when it is said that the stamens are inserted into the calyx of the flower of the apple, it is meant that they adhere to the calyx up to a certain point, from whence they appear to arise. The same must be said of their connection with other parts.

The *filament* of the stamen is the representative of the petiole of the leaf, and in structure and function resembles that organ, and it is not any more essential to the existence of the stamen than the petiole is to the leaf. The filament is sometimes rudimentary or wanting, so that the anther resembles a sessile leaf, in which the petiole is not developed. The filament is sometimes hair-like, and incapable of supporting the weight of the anther, as in the grasses. Frequently it is thick at the base, tapering upwards; sometimes it is dilated, and is forked at the summit, the anther being situated on one of the points. In some cases it is branching.

The filaments are often combined into a single mass, the anthers being separate. When this is the case, they are said to form a brotherhood, and the term *adelphia* is applied to them. When there is only one such combination, the stamens are said to be *monadelphous*, as in Malvaceæ; when there are two such unions, or even if only one stamen is separated from the rest, they are called *diadelphous*, as in Fumariaceæ and many Leguminosæ; when there are more than two, as in Hypericaceæ, they are *polyadelphous.* The filaments are sometimes of different lengths; when two are tall and two are short, as is seen in the whole of the order Labiatæ, they are called *didynamous;* if four are long and two are short, as is seen in the order Cruciferæ, they are *tetradynamous.* In the Compositæ the filaments are free, and the anthers slightly connected together; this condition is termed *syngenesious.*

The ANTHER is generally an oblong body divided perpendicularly into two lobes. The anther-lobes are to be regarded as hollow dilations of the blade of a leaf, its midrib being represented by the *connective*, which is generally a solid rib running down the middle of the anther, uniting the two lobes. The connective is sometimes prolonged beyond the anther-lobes. In other cases it is very broad, separating the anther-lobes widely, as in the distractile connective of Salvia. Each anther-lobe usually contains two pollen-sacs, in which the pollen-grains are formed. See POLLEN.

The number of stamens in flowers is expressed by a Greek numeral being prefixed to the word *androus:* thus flowers with one stamen are *monandrous;* with two stamens, *diandrous;* with three stamens, *triandrous;* and so on. When there are more than twelve stamens the flower is said to be *polyandrous.* Staminodes are stamens devoid of anthers, and therefore sterile.

It was on the number of stamens, and their arrangement and relations, that Linnaeus founded the classes of his sexual or artificial system of the arrangement of plants.

STAM'FORD, a municipal borough of England, in the county of Lincoln, situated on the left bank of the river Welland, 82 miles from London by the Great Northern Railway. A stone bridge of five arches crosses the river, and connects Stamford with a suburb in the bordering county of Northampton. The town is ancient, the streets irregularly laid out, and most of the houses are built of freestone and covered with slate. The Welland is made navigable to the town for boats and small barges.

There are six churches in Stamford, several of which are ancient, and one in the suburb on the right bank of the river. Some interesting monastic remains exist in and near the town. There are a town-hall, gaol, theatre, infirmary, several places of worship for dissenters, and numerous schools. Burghley House, the seat of the Marquis of Exeter, is in the vicinity. The municipal borough is governed by six aldermen and eighteen councillors. The parliamentary borough was merged into the county division in 1885. The population in 1881 was 8775. The village of Bridge Caserton, 2 miles distant, was a Roman station, through which the Irmin Street passed, and it is supposed that soon after the departure of the Romans their station fell to decay, and the town of Stamford began to rise up from some superior advantage of position. The first battle by the Saxons against the Picts and Scots was fought at Stamford in the year 449, and subsequently Stamford became one of the five great cities of the Danes.

STAM'INATE FLOWERS are those which have stamens, but no pistil.

STAMMERING. The terms *stammer* and *stutter* are synonymously adopted to denote that involuntary interruption of utterance arising from difficulty, and often total inability, to pronounce certain syllables, the speech apparatus being frequently affected with spasms in the effort to speak.

In some stammerers the spasm consists of involuntary movements similar to *chorea* (St. Vitus' dance), which occasionally affects other than the speech muscles. Stammer with this spasm distorts the utterance by an involuntary repetition of some part of the syllable, as g-g-g-good d-d-d-day. The repetitions may or may not be vocal. In other stammerers the spasm consists of involuntary immobility, similar to *tetanus* (lockjaw), commonly of the form termed *trismus*, in which the mouth is closed and the jaw cannot move to open it; and sometimes of the form termed *antitrismus*, in which the mouth is open, and the jaw is equally incapable of moving to shut it. The general conditions of respiration, vocalization, ennunciation, and articulation, under which stammering occurs, are subjoined.

I. *Respiration.*—1. Most stammerers manage their respiration badly, although nearly all can speak freely in a whisper. 2. They feel that they have insufficient breath to speak. This sensation, however, arises less from an insufficiency than from attempting to speak on an involuntary inspiration. The breath is expired to be vocalized by the voluntary action of the ribs, which mechanically contract the chest's cavity. The ribs, however, cannot accomplish this when they are in the position in which an involuntary inspiration leaves them; they must be raised to that position to which a voluntary inspiration carries them before they can act with mechanical effect upon the chest to expire a holding breath for the purpose of conversation. 3. With the sensation of insufficiency of breath some feel also a pain at the pit of the stomach. This pain is connected with attempting to speak on an involuntary inspiration, and its severity is commonly increased by struggling to speak.

II. *Vocalization.*—1. *Song-voice.* The song condition of voice seldom presents any difficulty to stammerers. Cases of stammer in the song-voice very rarely occur; and it is known that stammerers when struggling with a word are sometimes advised to sing it. 2. *Speech-voice.* Stammer occurs in all parts of the speech-note, more frequently, however, in the middle than towards the end, but most commonly at the initial. 3. *Pitch of Voice.* Changes of pitch, whether concrete or discrete (slide or skip), through narrow intervals of the scale, present difficulties which wider changes of pitch do not. Stammerers can mostly declaim, if they cannot converse or quietly read; and it is well known that wider intervals of pitch occur in declamation than in ordinary conversation. The measured movement of verse is easier for the stammerer than the unmeasured movement of prose and conversation.

The great majority of stammerers are of the male sex. Few stammer from their early infancy; children commonly speak freely until about five years of age. An occasional difficulty is first observed, which becomes more frequent up to the tenth year, when it is commonly at its maximum; although the spasm frequently increases in severity up to manhood. In the decline of life sometimes stammering spontaneously diminishes, and it has been known to entirely disappear. The voices of childhood and old age differ in several respects from that of the intermediate period of life. A comparison of these voices with the above-described vocal conditions of stammer will account for the occasional spontaneous disappearance of stammer in old age. The speech melody of infancy is set in a high pitch, which often runs into the falsetto, and is much intersected with wide intervals, both concrete and discrete. The voice of old age often falls into the tremulous scale, and the rate of utterance is slow, steady, and uniform. The accent is given to syllables by quantity rather than by stress, deliberate pauses are made, and the whole system is marked by the self-possession of experience, age conversing with a consciousness of superiority, if in nought else, in a longer reach of memory.

From what has been stated it appears that there are three functional causes of inability to control the muscular movements which are required for utterance, viz.:—

1. Spasm, both of the tetanus and chorea forms. All muscles are liable to spasm. Spasm of the larynx, the tongue, the lips, and the masseter muscle, are each sources of stammering.

2. Defect in the associating power, which combines the voluntary movements of different organs in one simultaneous act, or in an allied succession of acts. Defective association of vocalization with respiration will occasion stammer, for perfect association of the voluntary movements of the larynx with those of the chest are required in utterance. Some stammerers can associate the movements of the larynx and chest with facility, but they stammer from inability to associate with them the movements of the jaw and lips. And other stammerers who can associate these movements are unable to associate with them the movements of the tongue, and as a necessary consequence they stammer.

3. Involuntary associate movements: as after mimicking a stammerer it has been found that those muscular movements which in the mimicry were voluntarily associated with the proper movements of utterance, have suddenly become linked to them so firmly in allied motion that the mimicker is unable to dissociate them, and an actual stammer results. Thus those movements which were voluntary in the mimicry are now (in accordance with an ill-understood law of nervous action) excited independently of, or even contrary to, the will, by the voluntary impulse which is directed to effect the proper movements of utterance.

STAMPS, STAMP ACTS. Stamps are impressions made upon paper or parchment by the government or its officers for the purposes of revenue. They always denote the price of the particular stamp, or in other words, the tax levied upon a particular instrument stamped, and sometimes they indicate the nature of the instrument itself. If the latter is written upon paper, the stamp is impressed in relief upon the paper itself; but to a parchment instrument it is attached by paste and a small piece of lead, which itself forms part of the impression.

The stamp tax was introduced into this country in the reign of William and Mary, such an impost having previously existed in Holland. Various Acts were subsequently passed on the subject, and the schedule to the Act 55 Geo. III. c. 124, which consolidated all the previous Acts, occupies

nearly 100 octavo pages. The Act under which stamps were first introduced into this country imposed them upon grants from the crown, diplomas, contracts, probates of wills, and letters of administration, and also upon all writs, proceedings, and records in courts of law and equity; it did not, however, impose them upon deeds unless they were enrolled at the courts of Westminster or other courts of record. Two years afterwards conveyances, deeds, and leases were subjected to stamp duty; and by a series of Acts in the succeeding reigns, every instrument recording a transaction between two individuals was thus taxed before it could be used in a court of justice. By the 38 Geo. III. a similar duty was imposed on newspapers; and by an Act of Geo. IV. inventories and appraisements are required to be stamped. The tax on newspapers has long since been repealed. Stamps are also used as a convenient method of imposing a tax upon a particular class of persons: thus, articles of apprenticeship are subject to duty, and so are the articles of clerkship to a solicitor. Solicitors and conveyancers are required to take out annually a stamped certificate, and before a person commences practice as physician, advocate, barrister-at-law, or attorney, he must pay a tax, under the form of a stamp, upon admission.

The general principles which regulate the courts in the interpretation of the Stamp Acts are, that fraudulent evasion of the stamp duties shall be punished by forfeiture of all benefit from the document which ought to have been stamped; and that a just claim shall not be evaded or a fraud be effected because the just claimant has unintentionally violated the stamp laws. Accordingly, almost all instruments requiring stamps (except bills and notes) may be stamped on payment of a penalty; and all courts of civil justice are authorized to receive the unstamped instrument when tendered in evidence, on deposit of the amount of the stamp and penalty.

An unstamped instrument, though in general inadmissible, may be used as evidence to defeat fraud, and, with certain limitations, to establish a criminal charge. An indictment for forgery may be maintained although the instrument forged may be invalid for want of a proper stamp, but such an invalid instrument is not sufficient to support an indictment for larceny.

No branch of our taxation has exercised a more far-reaching influence than the stamp duties upon the social economy of the country. They have not only been fruitful causes of that dear law which has been the just complaint of all our law reformers, but by swelling exorbitantly the cost of transferring land they have intensified in a very marked degree the action of those other causes which were tending towards an accumulation of the soil of the country in the hands of a small number of proprietors. Almost every species of written or printed document necessary for carrying on the business of mankind was in course of time drawn within the grasp of the stamp laws. In most instances the duties exacted were immoderately excessive, and so complicated were the laws on the subject that it was often found impossible to say what stamp was legally required, and the most conscientious were therefore every day unintentionally incurring penalties. At length in 1850 a serious effort was made to bring the law into something like harmony with correct principles of taxation. Other efforts followed, and in 1870 three important Acts were passed consolidating the law relating to this subject, reforming its administration and introducing better principles of classification. Less important changes were also made in several succeeding years. The revenue derived from stamps now exceeds £11,500,000 per annum.

The stamp duties and the custody of the dies are placed under the superintendence of commissioners, who transact their business in Somerset House, London.

STAN'CHIONS are upright iron bars fixed in masonry or stonework to protect windows, to support floors, to strengthen walls, &c. Sometimes they are only let into the bottom, the tops, pointed off or ornamented, being encircled, as with a collar, by a pierced iron rod fixed at each end; while still another method has both top and bottom similarly free.

STANDARD, a military ensign. In these later days, a standard is usually a flag, but the use of flags does not seem to have been of great extent until the time of the later Roman Empire.

The standards of the Israelites mentioned in the first, second, and tenth chapters of Numbers were probably imitated from the well-known standards of the Egyptians, emblematic figures borne aloft on lofty poles. Later on we find military devices spoken of by Aischulos (Æschylus), in his drama of the "Seven against Thebes," but these were manifestly painted upon the shields of the heroes, after the manner of the coats of arms of the times of chivalry. Though not borne aloft, such designs would serve as distinguishing marks of the hero-leaders, and as rallying points, therefore, for their forces. Contemporary with this was the Persian white flag, described in Xenophon, bearing the favourite device of the eagle.

The ancient Roman standard was a wisp of hay tied to the end of a spear, but this soon disappeared in favour of symbolic figures of animals borne on spear-shafts. The cavalry had a wolf; the three divisions of infantry had a minotaur, a horse, and a wild boar respectively; and to these Caius Marius added the famous silver eagle of Rome for the standard of the legion as a whole. The new discipline and the new standard went together, and the old animal emblems swiftly disappeared before the "royal bird of Jove." Ever afterwards the Roman eagles led the Roman legions to victory. Subsequently the cohorts began to adopt small banners with stitched devices, hung on a cross-bar from a standard-pole. This kind of banner developed into the familiar LABARUM of the Christian (Byzantine) emperors.

The standards of the middle ages were borne just the converse way, flying out from a pole horizontally, instead of depending from it vertically, banner-fashion, like the labarum. Standards always tapered somewhat from their pole-end to their free end, which latter was always notched, except for royal ensigns. The length of the standard, which usually bore only a selection of the charges of the full coat, was varied according to the rank of its chief: that of a king, 8 yards; that of a duke, 7 yards; of a marquis, 6½ yards; and then by diminutions of half a yard onwards through earl, viscount, baron, and banneret, to the knight's ensign, of 4 yards long. The royal standard of the United Kingdom is in strictness a banner, since it contains the whole coat of arms, which a standard should not do. See also BANNER.

STANDARD, BATTLE OF THE, fought between the English and Scots on Cutton Moor, near Northallerton, 22nd August, 1138. The Scotch, under their king, David I., were totally defeated, with a loss of 10,000 men. The battle derived its name from the consecrated standard borne by the English army; a ship's mast with "the host" on its summit, and around it the banners of St. Peter of York, St. John of Beverley, and St. Wilfred of Ripon.

STANDARD MEASURE, WEIGHT, &c. The common purposes of life require a continual reference to lengths and weights, which it is intended shall be always the same, but as to which it is sufficient that they should be very nearly the same. Nature continually presents resemblances between the lengths and weights of similar things. The foot, the cubit, the palm, the digit, the fathom, &c., differ so little in different persons that the occurrence of these words as measures of length is not surprising.

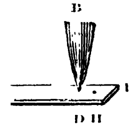
Measures are wanted for two distinct objects, the commercial and the scientific. The wants of natural philosophy have grown up within the last two centuries; while so

early as Magna Carta it was one of the concessions to the grievances of the subject, that there should be one weight and one measure throughout the land. But though a few Acts of Parliament were sufficient, in process of time, substantially to establish the political rights which that charter was intended to grant, hundreds of them, down to the present time, have scarcely succeeded in producing the use of one weight and one measure. This unity was for commercial, not for scientific purposes; and the resemblance of natural objects was supposed to be a sufficient reliance for obtaining it. Some of the old statutes expressly make the inch to be the length of three barleycorns, placed end to end, round and dry, from the middle of the ear. Standards were made no doubt from this definition; or at least it was supposed that if the existing standard should be lost, the barleycorns would enable its restoration to be effected. Our readers may smile at what they think so rude a contrivance; but the same principle carried a little further might be made very efficient in preserving a measure. Suppose, for example, that the government were now to think it desirable to recover the three-barleycorn inch, or at least to invent one which should be capable of being recovered. They would put together, not three barleycorns, but 3000 or 30,000, or many different collections of 3000 or more. The average inch deduced from these would be capable of being recovered at any time from the same grain grown in the same soil. A commercial standard might be easily restored from many different modes of proceeding; for example, the average height of the barometer at a given place throughout any period of five years is so nearly the same from one five years to another, that a commercial standard might be sufficiently well obtained from it. It would be of little consequence if the yard were wrongly recovered by one-hundredth or even one-tenth of an inch, in any matter of buying and selling.

It is the *scientific* standard at which the government has been aiming during the last century. The object here is, first, to measure the old standards to the utmost accuracy of which our senses, assisted by microscopes, are capable; secondly, to discover the means of reconstructing a lost standard. In the more delicate operations of natural philosophy and astronomy, our knowledge cannot go down to posterity unless we show within the thousandth of an inch what it is that we call a yard. The public at large has never understood the reason why so much trouble has been taken; and perhaps the members of different administrations, while intrusting such investigations to men of science, and relying on them for the whole conduct of the matter, may have wondered at the great difficulty which there seemed to be in the way of furnishing the shopkeepers of all generations with yard measures and pound weights of the same values.

To elucidate the *principle* merely of the manner in which scales are compared, we must first show how it is that very small lengths can be measured. A screw can be very accurately constructed, say, with threads one-twentieth of an inch apart: if this screw be the axis of a circular plate, which turns with it, and the edge of the plate be divided into 100 parts, each of these parts will be very perceptible, if the plate be three-quarters of an inch or more in diameter, and it will not be difficult to estimate the half or quarter of one of the divisions. Let there be an index attached to the frame, which does not move with the screw, so that by this it may be seen, when the plate (and with it the screw) is turned, how many divisions it is turned through. Now since a whole turn of the screw moves the end of it forward through one-twentieth of an inch, a motion of the plate which passes one of the divisions over the index, or the hundredth part of a turn, sends the end of the screw forward through only one two-thousandth of an inch, and a quarter of a division answers to one eight-thousandth of an inch. Suppose a couple of such screws, each of which is attached to a pointer, as in the following diagram, in which the pointers only are inserted, and one of the scales which are to be compared; the screws which move the pointers, and all the framework, being omitted. Observe also that this is not the apparatus employed, but only a convenient illustration of it.

It is supposed that A and B can be moved by the screw motion in such a manner that a motion so small as the eight-thousandth of an inch may be given to either. The



scale at present used is E F, on which are two points, C and D, which are, or are supposed to be, exactly a yard asunder. Let the screws be moved until the ends of the pointers, which all but touch the scale, are exactly over C and D; then if the scale be removed the length C D is retained in the distance between the points of the pointers. Now let another scale be introduced, and let its points be brought as near as may be, conveniently, to the pointers; it is supposed that the distances C D and G H are very nearly equal, for workmen used to the construction of mathematical instruments never fail in making two yard measures agree within a fiftieth of an inch. Perhaps the reader will say the point G might be brought *exactly* under the pointer A, and then the pointer B alone would show whether the present scale is shorter or longer than its predecessor; but as the pointer is much less cumbrous than the scale it is easier and safer to put the scale in a convenient position than to attempt to place it in one exactly given. This being done, move the pointer A from C to G, and observe how many turns, or how much of a turn, of a screw is required to do it: say it makes $87\frac{1}{2}$ divisions of the plate pass the index. Also move the pointer B from D to H, which makes, say, $97\frac{3}{4}$ divisions of the plate pass the index. Now we obviously have

$$GH = CD + DH - CG;$$

and since D H is longer than C G, it appears that G H exceeds C D by the excess of D H over C G, answering to $97\frac{3}{4} - 87\frac{1}{2}$, or $10\frac{1}{4}$ divisions of the plate, being $10\frac{1}{4}$ times the two-thousandth of an inch, or ·005125 of an inch. This experiment may be repeated any number of times, and as may be expected, the results will not agree, since it is not to be supposed that any two persons, or the same person at two different times, will agree in their estimation of exact coincidence between the pointers and the ends of the scales. As in other cases, the averaging of the discordant results will bring out the truth very nearly.

In 1854 the government, acting upon the report of a committee of scientific men, decided upon making the standard of length a line measure, the form of which should be a solid square bar, 38 inches long (so as to project an inch beyond the true yard at each end) and 1 inch square in transverse section; and the material an alloy of copper, tin, and zinc in the proportions of 16, $2\frac{1}{2}$, and 1 respectively. Out of a number of bars placed at the disposal of the commissioners, it was found that the length of 1 yard, as given by the old imperial standard, was represented by 6. These were finally adopted by the legislature; the first, No. 1, as the imperial standard yard, and the others as parliamentary copies, marked Nos. 2 to 6. No. 2 was deposited in the Royal Mint; No. 3 transferred to the Royal Society; No. 4 immured in the cell of the recess on the east side of the lower waiting hall in the new palace at Westminster; No. 5 sent to the Royal Observa-

tory at Greenwich; and No. 6 was retained for the comparison of other measures, or for any scientific purpose in which reference to the standard might seem to be required. Near to the ends of each of these bars a cylindrical hole is sunk to the depth of half an inch, and the distance between the centres of these two holes is exactly 36 inches. At the bottom of each hole is inserted in a smaller hole a gold plug or pin about one-tenth of an inch in diameter, and upon the surface of this pin there are cut three fine lines at intervals of about the one-hundredth part of an inch transverse to the axis of the bar, and two lines at nearly the same interval parallel to the axis of the bar; the measure of length of the imperial standard yard is given by the interval between the middle transversal line at one end and the middle transversal line at the other end, the part of each line which is employed being the point midway between the longitudinal lines; and the said points are in the Act of 1878, which is the most recent of the Acts regulating the standard, referred to as the "centres of the said gold plugs or pins."

The main standard yard is marked, "Copper, 16 oz.; tin, 2½; zinc, 1. Baily's metal. Parliamentary copy (VI.) of the Imperial Standard Yard. 41 & 42 Victoria, chapter 49. Standard Yard at 62° Fahrenheit. Cast in 1878."

All the old standard measures of capacity were abolished in 1824, and the new imperial standard gallon, containing 10 lbs. weight of water, and equal to about 272¼ cubic inches, was made the standard of capacity for liquid measures; and the imperial standard bushel of 8 gallons was made the standard for measuring dry commodities.

The English standard units of measure, capacity, and weight—the yard, the bushel, and the pound—have all come down to us from the Saxons with very little modification; indeed the yard, or gird, of the Saxon kings, which was kept at Winchester (and which is the earliest recorded standard of length in this country), has remained unaltered to the present day. The Winchester copy of the standard yard of Henry VII., which is still in existence, and which, there is every reason to believe, represents accurately the length of the old Anglo-Saxon yard, does not differ from our present standards more than 0·01 inch.

William the Conqueror decreed by statute that "the measures and weights shall be true and stamped in all parts of the country, as had before been established by law." In his reign the English standards were removed from Winchester and deposited in the crypt chapel of Edward the Confessor in the cloisters of Westminster Abbey, afterwards known as the Pyx chapel—the king's chamberlain being made responsible for their safe custody. In 1826, when this office was abolished, the care of the standards was transferred to the auditor of the exchequer; and upon the old establishment of the exchequer being remodelled in 1834, they were again handed over to the comptroller-general of the exchequer. In 1866 the exchequer ceased to be a separate department of the government, and was amalgamated with the audit office. A new office—that of warden of the standards—was then created, and placed under the Board of Trade; but in 1876 it was arranged that this post should no longer be held by a separately paid official, and since that time it has been annexed to that of the permanent secretary of the Board of Trade. From 1878 onwards the standards department of the Board of Trade has had the control of the standards. A large portion of the work of the department consists in continually verifying the local standards throughout the country—to which all appeals on disputed points are practically confined; for it is provided by statutes passed in 1859 and 1860 that throughout Great Britain and Ireland no copies of the standard weights shall be legal unless re-verified in the warden's department within five years, and no copies of the standard measures unless so re-verified within ten years. The department, however, has no power to compel the production of these standards for re-verification, and this regulation has been to a great extent ignored by the local authorities. Standard weights are never touched with the hand, but are carefully lifted either with a proper fork or with a wash leather, and are always carefully wiped with a wash leather after being used.

An additional set of standard decimal grain weights—made of hard brass—was constructed during the years 1875-76, to be used specially in trials of the Pyx.

As far back as 1841, and again in 1854, the standards commission recommended that mural standards of length should be securely fixed for public use in all populous towns; but as yet very little has been done in this direction, although the chairman of the commission, the astronomer-royal, felt its importance so strongly that he had the yard and smaller measures erected outside the wall of the Royal Observatory at Greenwich. Again, in 1867, the commission urged that these standards should be laid down in London, and during the years 1875-76 the government expended about £500 in carrying out this idea by making a solid platform of granite at the foot of the north wall of Trafalgar Square, extending the whole length, 259½ feet, upon which has been laid down the public standards of the surveying land chain of 66 feet, with divisions of ten links each, and of the building land chain of 100 feet, with divisions of 10 feet, and the first division of 10 feet subdivided into feet. The imperial yard, 2 feet, and 1 foot, with subdivided inches—and all with descriptive tablets—are also shown. The defining lines of the different measurements are on bronze blocks let into the granite, and the exact measurement is in the middle of each line. These "secondary standards of length" were legalized by an order of the queen in council, dated 27th June, 1876.

STANDARD TIME. See TIME.

STANDARDS, in horticulture, are those trees or shrubs which stand singly, without being attached to any wall or support. In gardening and planting they are distinguished into three kinds, the Full Standard, the Half Standard, and the Dwarf Standard.

The Full Standards are trees whose stems are suffered to grow 7 or 8 feet or more without allowing side branches to be developed, but at this point are allowed to spread in all directions.

Half Standards are those plants which are allowed to run up 3 or 4 feet, and then permitted to branch out. The height at which it is desired a tree should branch out may be frequently secured by cutting off the lower branches up to that point, or by cutting down the primary branch and allowing the highest lateral branches to develop themselves. Many shrubs grow naturally in this manner; and when fruit-trees are grown in this way, it is done as a matter of convenience for gathering the fruit, or insuring their growth under particular circumstances.

Dwarf Standards are those plants whose stems are only allowed to reach a height of 1 or 2 feet before they are permitted to branch, and this object is effected in the same manner as in the last. All kinds of fruit-trees, as apple, pear, plum, and cherry trees, may be grown as dwarf standards, but these trees do not bear so good fruit under such treatment as when allowed to grow as half or full standards.

STAN'DISH, MILES, the military leader of the first Puritan settlers of New England, was a cadet of the old family of that name, and born probably about 1565. He fought in the expedition sent by Queen Elizabeth to aid the Dutch. He afterwards, though not a member of their church, "settled with the English refugees at Leyden," and sailed with the Pilgrim Fathers in the *Mayflower* in 1620. When the settlement at Plymouth was begun he was unanimously chosen captain or chief military commander, and in his many conflicts with the Indians displayed

much more vigour than mercy. He died in 1656, at a very advanced age. The tradition of his matrimonial disappointment has been made the theme of a poem of Longfellow's—"The Courtship of Miles Standish." There is a full account of him in Belknap's American Biography.

STAN'FIELD, CLARKSON, R.A., an eminent English painter, was born at Sunderland, in Yorkshire, about 1798; the exact date seems uncertain. He spent much of his early life at sea, and it is said that at one time among his shipmates was the wit and dramatist, Douglas Jerrold. He had evinced an early love of art, but was led to apply himself specially to its cultivation by an accident which compelled him to quit the navy, a fall from the rigging having severely injured his feet.

Having frequently amused himself on board ship by scene-painting, he now determined to resort to his pencil as a means of support. He obtained an engagement at the Royalty Theatre, Wellclose Square; afterwards at the Coburg, now the Victoria; and finally at Drury Lane, where he inaugurated a new era of scene-painting, and produced a succession of masterpieces which had no inconsiderably beneficial influence on the public taste.

In 1820 he essayed with success the higher branches of his art; in 1823, conjointly with David Roberts and others, he founded the Society of British Artists; and in 1827, abandoning scene-painting altogether, he devoted himself to cultivate his wonderful powers as a painter of marine subjects. His excellence in this department soon obtained for him a deserved popularity. In 1833 he was elected an associate of the Royal Academy, in 1835 a member, and soon afterwards he painted a series of ten Venetian views for the Marquis of Lansdowne, which now adorn the banqueting-room at Bowood. The year 1836 was rendered memorable by his fine picture of the "Battle of Trafalgar." The still finer composition of "The Day after the Wreck" was completed in 1845. A long and glorious series followed, all distinguished by fidelity of spirit and beauty of colouring, by the salt and savour of the sea which Stanfield loved so well. The friendship of Stanfield ("Stanny") with Charles Dickens and with Macready was remarkably close and cordial. A life of honourable and successful labour was peacefully terminated on the 18th of May, 1867.

STANG (Old English *staeng*, a pole), a pole hoisted on men's shoulders, whereon the "stanger," he who had to ride the stang, was hoisted aloft and carried amidst universal derision. The offence thus punished by our forefathers of the middle ages was the ill-treatment of a wife.

STAN'HOPE, CHARLES, third Earl, eminent as a mechanician and inventor, was born 3rd August, 1753. He was educated at Geneva, and in early life displayed a strong love for mathematical study, gaining at the age of eighteen the prize offered by the Stockholm Society of Arts for the best treatise on the structure of the pendulum. Succeeding to the family honours in 1786, he became noted for the advanced liberalism of his opinions, being regarded either as an amiable enthusiast, or a dangerous demagogue, according to the depth of the party spirit of his critics. He invented the printing press which bears his name, suggested improvements in canal locks, manufactured a fireproof cement, an improved kiln for burning lime, designed two calculating machines, and gave Fulton, the builder of the first American steamboat, many useful hints and much valuable assistance. He also studied electricity, and in 1779 published his theory of what is called the "return stroke." He died at Chevening in 1816.

STAN'HOPE, JAMES, first Earl, an eminent British statesman, the eldest son of Alexander Stanhope, second son of Philip Stanhope, first earl of Chesterfield, was born in 1673. Entering the military service at an early age, he was in 1694 commissioned a captain in the foot guards. After serving in Flanders till the peace of Ryswick, he participated in the disastrous expeditions of 1702 and 1704 to the Spanish Peninsula; and in 1705, being then a brigadier-general, he shared in the Earl of Peterborough's brilliant Spanish campaign. In 1707 he was made major-general, and in 1708 appointed commander-in-chief of the British forces in Spain. The same year he captured Port Mahon, and reduced the island of Minorca. In 1710 he gained the battles of Almenara, 17th July, and Saragossa, 9th August; but on 27th November, he and the forces under his command, amounting to 2000 men, were surprised and attacked by the Duke of Vendôme at Brihuega, and after a gallant defence forced to surrender themselves prisoners of war. After the termination of the conflict, he returned to England and took his seat as a Whig in Parliament, to which he had been regularly returned since 1702. He was one of the managers for the Commons in the trial of Sacheverell in the beginning of 1710. George I. on his accession appointed him one of his principal secretaries of state, and in April, 1717, he was made first lord of the Treasury, being a few months afterwards raised to the peerage as Baron Stanhope of Elvaston and Viscount Stanhope of Mahon. In 1718 he resumed his office of secretary of state, and was created Earl Stanhope. The same year he proceeded first to Paris, and thence to Madrid, to endeavour to avert hostilities with Spain, an attempt in which he did not succeed, and he was afterwards more than once employed in similar negotiations abroad. His death was very sudden. While speaking with much vehemence in the House of Lords in reply to the notorious Duke of Wharton, he burst a bloodvessel and died the next day, 5th September, 1721.

STAN'HOPE, LADY HESTER LUCY, an eccentric English lady, daughter of Charles, third earl Stanhope, and Hester, daughter of Pitt, first earl of Chatham, was born in London, 12th March, 1776. When about twenty years of age she entered the family of her uncle, William Pitt, with whom she lived until his death in 1806, acting as his private secretary and sharing his confidences. At his death he recommended her to the care of the nation, and she received a pension of £1200, which proving inadequate to support her in her former rank and style, she retired to solitude in Wales. In 1810, impelled by a strange belief in her destiny, she left England, and after wandering restlessly for a year or two on the shores of the Mediterranean, she repaired to Syria, and finally settled in 1813 at the deserted convent of Mar Elias, beside the little village of Jun and within 8 miles of Sidon. Here, wearing the dress of an emir—weapons, pipe, and all—she ruled her Albanian guards and her servants with absolute authority. The old convent, perched upon an isolated eminence among the wildest scenery of the Lebanon, was soon converted into a fortress garrisoned by Albanians, and it became a refuge to all the persecuted and distressed who sought her assistance. So powerful was the influence which she wielded over the surrounding country, that Ibrahim Pasha, when about to invade Syria in 1832, was constrained to solicit her neutrality. After the siege of Acre in the same year, she is said to have sheltered several hundred refugees. She adopted, along with the garb of a Mohammedan chieftain, a good deal of the Mohammedan religion, and her faith seems to have been based both upon the Koran and the Bible. She practised astrology and other secret arts, and always kept in a magnificent stable two mares, on which she fancied she was to ride into Jerusalem with the Messiah at his next coming. During the latter years of her life, when her profuse liberality had loaded her with debt, she was compelled to submit to many humiliations, and she died 23rd June, 1839, with no European near, surrounded by a crowd of native servants, who plundered the house of everything that could be stolen the moment that the breath left her body. She was buried in the garden

adjoining her residence. Her "Memoirs as related by Herself" (three vols. 8vo) and "Travels" (three vols. 8vo), edited by Dr. Meryon, who had been her physician for several years, were published in London, 1845-46.

STAN'ISLAUS I. (LESCKZINSKI), King of Poland, born on the 20th of October, 1682, was the son of Raphael Lesckzinski, palatinate of Posnania, and grand-treasurer of Poland. The family name was derived from Lesckno, a town founded by an ancestor. Stanislaus was most carefully educated by his father, and became accomplished in learning and in all the arts of life. At the age of nineteen he was sent as a representative of his province to the diet assembled to elect a successor to King John Sobieski. Frederick Augustus I., the elector of Saxony, who was elected, conferred upon Stanislaus, on his father's death, the palatinate of Posnania. Discontent at the presence of Saxon troops soon manifested itself in Poland. Frederick Augustus formed an alliance with Peter I. of Russia. A party of malcontents at Warsaw deputed Stanislaus to visit Peter's enemy, Charles XII. of Sweden, and the gifted young Pole produced a very favourable impression on the mind of the Swedish king. Relying on the promises of Charles the diet at Warsaw declared Frederick Augustus deposed, and the throne vacant, in May, 1704, and on the 12th July following Stanislaus was elected king, Charles being at the time *incognito* with his ambassador at Warsaw. A fierce war continued to rage between Charles XII. and Stanislaus on the one hand, and Peter the Great and Frederick Augustus on the other. The triumphs of the Swede had apparently fixed Stanislaus firmly on the throne of Poland, when his mad attempt to seize Moscow and dethrone Peter brought about his crushing defeat at Pultava. Stanislaus spent a year in honourable captivity by the Turks. In 1714 he left Bender for the principality of Deux-Ponts, where he remained till January, 1720, when, poor and proscribed, he turned for refuge to France. After passing some years in philosophic ease at Weissemburg in Alsace, and having seen his daughter married to Louis XV., he was induced in 1733, on the death of Augustus II., to accept the invitation of the Poles to become their king again. He reached Warsaw in disguise on 8th September, 1733. He was at once driven into Dantzic, and besieged by Marshal Münnich, and unable to endure the prolonged sufferings of the townspeople he advised their surrender, while he took flight in the disguise of a peasant. According to the terms of the treaty of Vienna he abdicated the throne of Poland, and was put into possession of the duchies of Lorraine and Bar. Here he lived like a philosopher on the throne, and acquired the humane title of the Beneficent. "Your majesty," wrote Frederick the Great to him, "gives in Lorraine an example to all kings in making the people happy; that is the sole business of sovereigns." The death of this amiable and accomplished prince resulted from an accident. His dressing gown caught fire, and being blind his endeavours to extinguish the flame made him fall into the fire. He lingered for some weeks in great pain, and died 23rd February, 1766. His writings have been collected under the title of "Œuvres du Philosophe Bienfaisant," four vols. (1763).

STAN'ISLAUS II. (PONIATOVSKI), King of Poland, was born at his father's seat in Lithuania on the 17th of January, 1732. He was educated with care in the Roman Catholic religion, and soon became distinguished by the external graces of his person, and by the superiority of his mental attainments. On making a tour through Europe he lived too extravagantly for his small fortune, and was arrested for debt at Paris. At London he was more fortunate, for making the acquaintance of Sir Hanbury Williams, he became attached in 1755 to the English embassy at St. Petersburg, of which Sir Hanbury was the chief. One part of Williams' instructions was to gain over to English interests the Grand-duchess Catharine, who, having become thoroughly disgusted with her sottish husband, and dissatisfied with her absent lover Soltikoff, looked with favour upon the handsome Polish attaché, then in his twenty-third year. Stanislaus was not insensible to her wit and beauty, on which he enlarges in his memoirs. A correspondence carried on by means of Leon Narishkin resulted in a relationship so ardently tender between the lovers that Catharine was accustomed to escape in male attire from the palace at night, when she was supposed to be in bed, and hold rendezvous with Poniatovski. From this time forth the grand-duchess became the arbiter of his fate. At her suggestion he went back to Poland in 1756, and by her influence was appointed Saxo-Polish minister at St. Petersburg. The importance and authority thus obtained greatly facilitated their guilty intercourse. Indeed the Grand-duke Peter, after once surprising Stanislaus at Oranienbaum, and filling him with the dread of his vengeance, grew to be well pleased with the connection which so dishonoured him, and even promoted the return of Stanislaus from Poland in the character of an ambassador. The scenes depicted by Catharine in her memoirs of the little suppers she gave clandestinely in her bedchamber to Poniatovski and the three sisters Narishkin are worthy of Marivaux or Molière. "Count Poniatovski," she says, "when going about, always wore a wig of fair hair and a cloak, and to the question of the sentinels, 'Who goes there?' was accustomed to answer that he was a musician to the grand-duke. This wig made us laugh a good deal." Notwithstanding this frolicsome abandonment, the grand-duchess mingled ambition with love, and Stanislaus was employed in an intrigue with the Chancellor Bestucheff, the object of which was to give Catharine a share of the sovereign power when her husband should become emperor. The chancellor was arrested, and a correspondence with him carried on by Poniatovski led to the recall of the latter by the King of Poland, at the request of the Russian government, in 1759. Peter III., after reigning about a year, was dethroned by his wife, who became empress in 1762. The letter to Stanislaus in which Catharine narrates the events of her accession, terminates with these words:—"Without losing a moment I send Count Kayserling ambassador to Poland to make you king." The stalwart Orloff, however, had taken the place of the handsome Pole in the heart of the empress. She disregarded Poniatovski's request to be near her. "Do not make me king," he wrote in January, 1764, "but call me near you again." "I do not wish to be king," he said afterwards, "unless I can rely upon being married to her Majesty. Without the empress a crown has no attractions for me." Nevertheless he accepted the crown, which was to bring him so much sorrow and humiliation. As the nominee of Russia he soon found that he had lost all independence as a sovereign. He tried to govern Poland wisely and liberally, but was thwarted by the opposing factions. His attempts to maintain religious toleration for dissenters excited the bitter hostility of some bigoted Roman Catholics—forty of whom bound themselves together in 1771 to seize or slay the king. On Sunday night, the 3rd of September in that year, his carriage was stopped in Warsaw; he was dragged out, wounded, and hurried out of the town. The conspirators lost themselves in a forest, and all except the leader, named Kosinski, ran away. This leader yielded to his prisoner's remonstrances, and led him to a place of safety. In 1773 Stanislaus witnessed the first partition of his country, of which, indeed, he was partly the instrument. Twenty years later occurred the second partition, and this shadow of a king was sent to reside at Grodno, on a pension received from the spoilers of Poland. In 1796 he was invited to St. Petersburg by the Emperor Paul, who, under a show of ceremonious civility, made him feel that he was a Russian subject. Embarrassed by debts and vexed by the treatment he met with, his health gave way

and he died on the 12th February, 1798, and was buried in the Catholic church at St. Petersburg. ("Mem. Secrets de Stanislaus Auguste," Leipzig, 1862; "Memoirs of Catharine II.," London, 1850; "History of Poland.")

STAN'LEY. See DERBY, EARL OF.

STAN'LEY, ARTHUR PENRHYN, Dean of Westminster, was born at Alderley, Cheshire, 13th December, 1815. His father was Dr. Edward Stanley, rector of Alderley for thirty-two years, and bishop of Norwich from 1837, a man of high attainments and exemplary character: his mother, Catherine Stanley, being a lady in all respects worthy of her husband. The young Arthur received his first education at home under the superintendence of his father, but in 1829, the year after Dr. Arnold's appointment to the headmastership of Rugby, he was sent to Rugby, where he remained until 1834, when he won a scholarship at Balliol, and went into residence at Oxford. A sketch of his character and influence during his stay at Rugby is given in "Tom Brown's Schooldays," in which he figures as Arthur. At Oxford he proved a very successful student, being in 1837 elected Ireland scholar, placed in the first class in classics, and awarded the Newdigate prize for a poem on "The Gypsies." In 1838 he became fellow, and in 1841 tutor at University College, retaining the latter office twelve years, until he was appointed Secretary to the Oxford University Commission. In 1850 he was made Canon of Canterbury, and in 1853 he became regius professor of ecclesiastical history at Oxford, and it was in this professorate that he composed his "Lectures on the History of the Eastern Church" and his "Lectures on the Jewish Church." In 1862 he was chosen by the Queen to accompany the Prince of Wales in his Eastern tour, and the following year he was appointed to the deanery of Westminster, and it was during the eighteen years through which he sustained this office that the best work of his life was accomplished. In 1863 he married Lady Augusta Bruce, sister of Lord Elgin, and for many years a personal friend and attendant of the queen. Thenceforward his position as a leader of theological opinion, of philanthropy, and of society, overshadowed his work as a man of letters, and being heartily and ably supported by his wife, who sympathized with him so thoroughly in all his efforts that he was wont to say he had never really lived until his marriage, he gave Westminster Abbey a place in the history of religious thought and feeling in England which it had never taken before. As the acknowledged leader of the Broad Church party he became frequently involved in controversy, and as his own sympathies were strongly in favour of a liberal theology, he was ever found contending for the principles of toleration, charity, and comprehensiveness. In 1872, in the face of strong opposition, he was appointed one of the select preachers at Oxford, and in 1875 he was elected rector of the University of St. Andrew's. It is probable that had he been so minded, he might have occupied a seat on the episcopal bench, but he preferred the unique position in the church for which he was so eminently suited, and remained Dean of Westminster until his death, which took place 18th July, 1881.

With respect to his work as an author he published, in 1844, "Dr. Arnold's Life and Letters," one of the most perfect pieces of biography in the English language, which has passed through numerous editions, and been translated into several foreign languages; "Sermons and Essays on the Apostolical Age" (1847); "The Epistles of St. Paul to the Corinthians, with Critical Notes and Dissertations" (two vols., 1855; fourth edition, 1874); "Historical Memorials of Canterbury Cathedral" (8vo, 1855; fifth edition, 1869), a fascinating work, and the first to reveal his powers as a master of the historical picturesque; "Sinai and Palestine" (8vo, 1856), a book which took its place at once as a classic, and which has since passed through more than twenty editions; "Lectures on the History of the Eastern Church" (1861); "Lectures on the History of the Jewish Church" (part I., 1862; part II., 1865; part III., 1876); "The Bible, its Form and Substance" (1862); "Scripture Portraits, and other Miscellanies" (1867); "Historical Memorials of Westminster Abbey" (1867; fourth edition, 1874); "Essays on Church and State" (1870); "The Athanasian Creed" (1871); "Lectures on the Church of Scotland" (1872); and "Addresses and Sermons at St. Andrews" (1877).

STAN'NARY (from the Latin *stannum*, tin). This term sometimes denotes a tin mine, sometimes the tin mines of a district, sometimes the royal rights in respect of tin mines within such district; but it is more commonly used as including the tin mines within a particular district, the tinners employed in working them, and the customs and privileges attached to the mines, and to those employed in digging and purifying the ore.

The great stannaries of England are those of Devon and Cornwall, of which the stannary of Cornwall is the more important. The stannaries of Cornwall and Devon were granted by Edward III. to the Black Prince, upon the creation of the duchy of Cornwall, and are perpetually incorporated with that duchy. In general both stannaries are under one duchy-officer, called the lord-warden of the stannaries, with a separate vice-warden for each county. The stannary of Cornwall is subdivided into the stannary of Blackmore, in the eastern parts of the county, and the stannaries of Tywarnhaile, Penwith, and Helston, in the west.

All tin in Cornwall and Devon, whoever might be the owner of the land, appears to have formerly belonged to the king, by a usage peculiar to these counties. King John, in 1201, granted a charter to his tinners in Cornwall and Devonshire, authorizing them to dig tin and turves to melt the tin anywhere in the moors and in the fees of bishops, abbots, and earls, as they had been used and accustomed. This charter was confirmed by Edward I., Richard II., and Henry IV. In Cornwall the right of digging in other men's land is now regulated by a peculiar usage, called the custom of *bounding*. This custom attaches only to such land as now is or anciently was *wastrel*, that is, land open or uninclosed.

As part of the stannary rights, the Duke of Cornwall, as grantee of the crown, has or had the pre-emption of tin throughout the county, a privilege supposed to have been reserved to the crown out of an original right of property in tin mines; but in modern times it is never exercised.

The duties payable to the Duke of Cornwall on the stamping or coinage of tin were abolished by 1 & 2 Vict. c. 120. The stannary courts are courts of record resembling the palatine courts; the judge is called a vice-warden. By the Judicature Act the appeal is to the Court of Appeal.

STAN'NIC ACID. See TIN.

STANOVOI' MOUNTAINS, a long mountain chain of Eastern Asia, which extends between 50° and 67° N. latitude, separates SIBERIA from the Chinese dominions, and is afterwards prolonged through the province of Okhotsk to Behring Straits. The total length is estimated at 3000 miles. The chain is very elevated and rugged, and its peaks are covered with perpetual snow. Russian explorations in 1863 proved that the Yablonoi Mountains, which were formerly supposed to be a continuation of this range, have no existence in fact, the Yablonoi district being merely an undulating plateau.

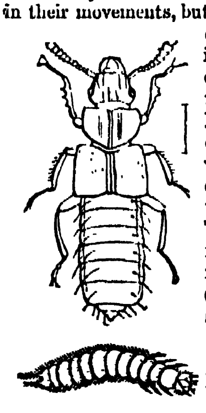
STAN'ZA, an Italian word which means room or dwelling-place, is used in poetry to designate certain parts or divisions of a poem, each forming a complete period within itself, and consisting of a number of lines regularly adjusted to each other. There is a great variety of stanzas in the poetry of modern languages, according to the rhythm and structure of the piece. Among the most common are the tiercet or triolet (*terzina*), of three lines, used chiefly by the

Italians and Spaniards; the *quatrain*, of four lines; the *ottava rima*, of eight lines; the Spenserian stanza, and the sonnet.

STAPE'LIA, is an extensive and curious genus of plants belonging to the order ASCLEPIADEÆ, natives of the Cape of Good Hope. The species are succulent, leafless, branching plants. The branches are four-sided, toothed, and covered with dark tubercles. The flowers are large and very beautiful, but possess a most fetid odour. One of the best known species is the Carrion-plant (*Stapelia hirsuta*), the smell of which so much resembles carrion that flesh-flies deposit their ova in the flower, and when the maggots are produced they are starved for want of food. *Stapelia pulvinata* is the most elegant of the species, and notwithstanding its unpleasant odour the Dutch natives of the Cape call it the Arabian Rose.

STAPHYLE'A is a genus of plants belonging to the order SAPINDACEÆ. There are four species, natives of the temperate regions of the northern hemisphere. They are shrubs, with opposite pinnate leaves, and white pendulous flowers in axillary racemes or panicles. *Staphylea pinnata* (common bladder-nut) is a native of woods and thickets in the middle and South of Europe. It is admitted by some into the British flora on the ground of its occurring occasionally in hedges and thickets in Yorkshire. It is frequently planted in shrubberies as an ornamental shrub, for which it is well adapted. *Staphylea trifoliata* (three-leaved bladder-nut) is a native of North America, where it is found on dry hills in rocky situations from New York to North Carolina. It is also frequently cultivated as an ornamental shrub.

STAPHYLIN'IDÆ is a family of Beetles belonging to the group BRACHELYTRA. This family is very rich in species, about 5000 having been described, distributed over all parts of the world. A large number of species are found in the nests of ants. Some are found among flowers and fungi, living on other insects and their larvæ; and others live in carrion, dung, &c., and feed on decaying animal and vegetable matter. Some inhabit almost exclusively seaweed on the sea-shore. They are all active in their movements, but are seldom seen on the wing in the day-time. The body in this family is long and flexible, and the elytra or wing-cases are so short that they leave the abdomen exposed. Many species have the habit of curling up the tip of the abdomen; when the insect is disturbed, a fetid odour is emitted from glands at the tip of the abdomen in many species. The larvæ closely resemble the perfect insects, and are generally carnivorous. The Devil's Coach-horse (*Ocypus olens*) is a common British species of Staphylinidæ. *Staphylinus villosus*, common in North America, is called the fish-fly in Newfoundland, from its habit of devouring the dying cod-fish. *Velleius dilatatus*, a British species, is a parasite in the nests of hornets. The annexed figure shows a species of Oxytelus and its larva.



STAPHYLO'MA is an affection in which some part of the eyeball is protruded beyond its natural position. It may exist in either the cornea or the sclerotica, and, according to its seat, is named *Staphyloma corneæ* or *Staphyloma scleroticæ*. Its treatment, in which the main object is to prevent the increase of the protrusion, and to relieve the pain to which the distension of the diseased parts gives rise, must vary with the circumstances of each case: the extreme measure is the removal of the protruded portion of the cornea.

STAPLE, "anciently written *estaple*, cometh," says Lord Coke, "of the French word *estape*, which signifies a mart or market." It appears to have been used to indicate those marts both in this country and at Bruges, Antwerp, Calais, &c., on the Continent, where the principal products of a country were sold. The staples were confirmed or appointed in England by the king (2 Edw. III. c. 9). All merchandise sold for the purpose of exportation was compelled either to be sold at the staple or afterwards brought there before exportation. This was done with the view of accommodating the foreign merchants and of enabling the duties on exportation to be more conveniently and certainly collected. Afterwards the word staple was applied to the merchandise itself which was sold at the staple. The staple merchandise of England at these early times, when little manufacture was carried on here, is said by Lord Coke to have been wool, woolfells or sheepskins, leather, lead, and tin. Incident to the staple was a court called "the court of the mayor of the staple." This court was held for the convenience of the merchants, both native and foreign, attending the staple. It was of great antiquity; the date of its commencement does not appear to have been certainly known. Many early enactments exist regulating its proceedings. Most of these were passed during the reigns of the first and third Edwards. The first of importance is called the Statute of Merchants or the Statute of Acton Burnel, and was passed in the eleventh year of Edward I. (1283.) [See ACTON BURNEL, STATUTE OF.] That which was passed in the twenty-seventh year of Edward III. c. 2, is entitled the Statute of Staple. One object of it was to remove the staple previously held at Calais to various towns in England, Wales, and Ireland, which are appointed by the statute. It directed proceedings similar to those prescribed for obtaining a Statute Merchant by means of a sealed recognisance, in consequence of which execution might be obtained against the lands and tenements of the debtor in the same manner as under a Statute Merchant.

A variety of other statutes were passed in the same and succeeding reigns, in some respects confirming, in others altering the provisions of the leading statute. As commerce became more extended, the staple appears to have fallen into disuse. Lord Coke, a great worshipper of antiquity, complains that in his time it had become a shadow.

STAR. The total number of stars which can be seen in the heavens by the average naked eye may in round numbers be stated as 5000. The smallest increase of telescopic power shows that the lucid stars are but only a very minute fraction of the total number. Take, for instance, the well-known region included between the four stars forming the great rectangle in the constellation of the Great Bear. [See GREAT BEAR.] On an ordinary clear night an acute eye will detect some minute stars in this region, perhaps half a dozen, more or less, according to the clearness of the sky and the power of the eye. If the same region be then examined with a small telescope or opera glass, instead of the few stars seen only with difficulty before, there will now be from 100 to 200 stars brilliantly conspicuous. With a still higher power the number of stars will be increased, so that they are actually present in thousands. It is not to be supposed that the region under consideration is exceptionally rich in stars; the same phenomena can be observed in perhaps every other part of the heavens. It would seem that for every star visible by the unaided eye there must be hundreds or even thousands of stars too minute to be seen without artificial aid. Systematic attempts have been made to estimate the number of stars in the whole heavens. Such attempts have been founded on counts made of the number of stars seen with powerful telescopes in limited areas which may be regarded as samples of the general condition of star distribution. From the counts thus made by Her-

schel's twenty-foot telescope, Struve has estimated the number of stars visible with that instrument to be 20,000,000. The larger telescopes of modern times would no doubt reveal many more, not improbably 50,000,000 stars in the case of the very largest instruments.

The stars are classified, according to their brightness, in different magnitudes. The very brightest stars are said to be of the first magnitude; those next brightest, of the second magnitude; and so on down to about the sixth magnitude, which is practically the limit of stars visible to the unaided eye. With the telescope the scale is continued much further downward. Telescopes of a most moderate size will show stars of the ninth or tenth magnitudes, while the more powerful instruments continue the series down to the fourteenth, or even lower still. The total number of stars visible to the unaided eye, and lying between the North Pole and the circle 35 degrees south of the equator, is about as follows:—

Of magnitude	1	there are about	14	stars.
"	2	"	48	"
"	3	"	152	"
"	4	"	313	"
"	5	"	854	"
"	6	"	2010	"

Total visible to naked eye, 3391 stars.

Nearly all of these are visible from the latitude of the south of England.

The relation between the brilliancy of the stars of the successive magnitudes is somewhat difficult to state. There is no very definite photometric principle involved in the relation between each magnitude and the adjacent magnitudes. The arrangement of the magnitudes has gradually arisen by the estimation of individual observers. So far as the subject admits of accurate statement, we may say that it would take about

$2\frac{1}{2}$	stars of	magnitude	2	to make one	of the first.
6	"	"	3	"	"
16	"	"	4	"	"
40	"	"	5	"	"
100	"	"	6	"	"
10,000	"	"	11	"	"
1,000,000	"	"	16	"	"

It will of course be understood that between the various magnitudes there are stars of graduated brilliancy, and for very accurate purposes the interval between two consecutive magnitudes is subdivided into tenths. Thus, 5·8 represents a star which has a brightness eight-tenths of the way from the fifth to the sixth magnitudes. A very exceptional case is that of Sirius, which is four times as bright as any other star of the first magnitude.

From the earliest times laborious care has been expended in determining the pl es of the stars. The results of such observations are included in star catalogues. The earliest catalogue known to us is that of Hipparchos (B.C. 150). This catalogue shows that the constellations were much the same 2000 years ago as they are at present. Of more recent labours Professor Newcomb writes: "Our modern catalogues may be divided into two classes, those in which the position of each star in the celestial sphere (right ascension and declination) is given with all attainable precision, and those in which it is only given approximately, so as to identify the star or distinguish it from others in its neighbourhood. The catalogues of the former class are very numerous, but the more accurate ones are necessarily incomplete, owing to the great labour of making the most exact determination of the position of a star. There are perhaps between 10,000 or 20,000 stars the positions of which are catalogued with astronomical precision, and 100,000 more in which, though entire precision is aimed at, it is not attained. Of the merely approximate catalogues the greatest one is the 'Durchmusterung' of Argelander, which enumerates all the stars down to the ninth magnitude between the Pole and 2 degrees south of the equator. The work fills three thin quarto volumes, and the entire number of stars catalogued in it exceeds 300,000. This 'star census' is being continued to the South Pole at the observatory of Ardoba, South America, by Dr. Gould. Of the millions of stars of the tenth magnitude and upwards hardly one in a thousand is or can be individually known or catalogued. Except as one or another may exhibit some remarkable peculiarity they must pass unnoticed in the crowd." In the *Nautical Almanac* for each year will be found a catalogue of about 200 stars, giving their right ascensions and declinations for every ten days with the greatest refinement of accuracy. It is those standard stars which are used for the determination of time, and they form the basis on which much astronomical work ultimately rests.

Many stars undergo remarkable fluctuations of brightness, and are termed in consequence variable stars. More than 100 stars of this kind are now known, but in the majority of cases the changes are of such a slight character that careful observation is necessary in order to see them. There are, however, two stars in which the fluctuations are so remarkable that they can be readily detected by the casual observer who will look at the proper times. These stars are Algol and Mira. The former of these is in the constellation of Perseus (right ascension, 3 hrs. 0 min.; declination $+40°\ 27'$). Owing to the convenient situation of Algol it may be seen every night in the latitudes of the United Kingdom; but for observations in the evening the best seasons are autumn, winter, and spring. Algol is usually of the second magnitude, but in a period of between two and three days, or more accurately, in a period of 2 days 20 hrs. 48 mins. 55 secs., it passes through a most remarkable cycle of changes. These changes commence by a gradual diminution of the brightness of the star from the second magnitude down to the fourth in about three or four hours. At the fourth magnitude the star remains for about twenty minutes, and then begins to increase in brightness again, until after another interval of three or four hours it regains the second magnitude. It remains at the second magnitude for about 2 days 13 hrs., when the same series of changes commences anew. STELLA MIRA, or Mira, is o Ceti (right ascension, 2 hrs. 13 mins.; declination $-3°\ 34'$). The period of the changes of this star is 331 days 8 hours. For about five months of this time the star is quite invisible. It then gradually increases in brightness until it becomes of the second magnitude. After remaining at its greatest brightness for some time, it again gradually sinks down to invisibility. The most rapidly changing of all the variables is that recently discovered by Mr. Sawyer: D M $+1°$, 3408, the place for 1855 being—right ascension, 17 hrs. 9 mins. 11 secs.; declination $+1°\ 22{\cdot}6'$. This star fluctuates between a magnitude 6·0 and 6·7 in a period very nearly 20 hrs. 4 mins. A very extraordinary variable star, η Argus, is found in the southern heavens, which gradually increased until, in March, 1843, it was second only to Sirius. During the succeeding twenty-five years it slowly diminished. In 1867 it was barely visible to the naked eye, and has not yet begun to recover its brightness. Professor Schönfeld of Bonn has published a complete catalogue of known variable stars, the total number being 143. Occasionally new stars have blazed forth. The most recent remarkable instance is that of November, 1876, when a new star of the third magnitude was discovered by Schmidt of Athens in Cygnus. This star gradually faded away, and has long ceased to be visible to the unaided eye, while the last telescopic report of its appearance states that it has in the spectroscope the appearance of a planetary nebula.

Many, perhaps most, of the stars possess what is known as a *proper motion*, in virtue of which the place of the star gradually changes in the heavens. These movements are no doubt very slow, the most rapid proper motion certainly known being that of the star Groombridge (1830), amounting to seven seconds per annum. The slowness is, however, really only apparent. The intrinsic velocity of Groombridge (1830) cannot be less than 200 miles a second.

The phenomena of double stars present many features of great interest; upwards of 10,000 objects coming under this designation are now recognized. In many cases the occurrence of two stars so close together as to form a double star is really only accidentally due to the two objects lying near the same line of vision. In others, however, there can be no doubt that the stars are actually connected together. One of the finest double stars is Castor (α Geminorum), [right ascension, 7 hrs. 26 mins.; declination +32° 17′]. Viewed by the unaided eye the two stars together resemble but a single star, but in a moderately good telescope it is seen that what appears like a single star is in reality two separate stars. The angular distance is about five seconds. By careful measurements of this star it is found that one of the components revolves around the other. The period is not accurately determined, but is certainly some centuries. It has been shown that the orbits in which the stars move are ellipses, and that they are obedient to the law of gravitation. One of the most rapidly moving double stars is 42 Comæ Berenices, the period of which is only 25·7 years. By means of certain binary stars it has been possible to determine the mass of the stars relatively to the mass of our sun. It has thus been ascertained that many of the stars have masses which rival, and in some cases exceed, the mass of our sun. This illustrates the most majestic truth which astronomy has yet disclosed to us, viz. that while our sun is only a star, other stars are in reality suns.

The stars are all at such enormous distances from the earth, that even the diameter of the earth's orbit, 186,000,000 miles, is almost inappreciable in comparison therewith. By observing the place of a star at different seasons of the year, a minute apparent displacement of the star can in some cases be measured, which is due to the annual change of the position of the earth. The nearest fixed star of which the distance has yet been found is α Centauri, at a distance of 20,000,000,000,000 miles. In the northern hemisphere the nearest star is 61 Cygni, at a distance of 43,000,000,000,000 miles.

The colours of stars are often very remarkable. From brilliant white stars, such as Sirius or α Lyræ, we pass by imperceptible gradations to ruddy, red, and even deep crimson stars. The bluish colours are more rare. Indeed it is a very remarkable circumstance that isolated stars of these hues are hardly ever found, but that occasionally one member of a close pair will be blue, purple, or violet, while the other in such cases is usually of an orange or ruddy colour.

Spectroscopic researches have of late years thrown much light on the nature of the stars. The spectrum of a star is, in fact, a miniature solar spectrum, consisting of all the colours of the rainbow shaded over by dark lines. The arrangements and the grouping of the lines vary, however, from one star to another in correspondence with the different materials present in each star. The large and important class of brilliant white stars, such as Sirius and α Lyræ, have a spectrum of a very remarkable type, with comparatively few dark lines, but with these lines of great intensity, and proved by Mr. Huggins to be due to the presence of hydrogen in the atmosphere.

Position of the Chief Stars.—In acquiring a knowledge of the particular stars, it will be most convenient to begin with such as never set in our climates; after which we may readily refer the situations of others to their position with respect to these, so that the reader can easily find them in the heavens or on a chart, as for instance, on the Plates CONSTELLATIONS, in the present work.

The Great Bear is the most conspicuous of the constellations which never set in our latitude; it consists of seven principal stars, placed like the four wheels of a waggon, and its three horses, except that the horses are fixed to one of the wheels. The hind wheels are called the pointers, because they direct us to the Pole-star, in the extremity of the tail of the Little Bear; and further on to the constellation Cassiopeia, which is situated in the Milky Way, and consists of several stars nearly in the form of the letter W; or we may easily imagine them to represent a chair, whence these few in particular form what is more commonly called Cassiopeia's Chair.

The two northernmost wheels of the Great Bear, or Charles's Wain, point at the bright star Capella, in Auriga. Descending along the Milky Way from Cassiopeia, if we go towards Capella, we come to Algenib, in Perseus, and a little further from the pole to Algol, or Medusa's Head; but if we take the opposite direction, we arrive at Cygnus, the Swan, and beyond it, a little out of the Milky Way, is the bright star Lyra. The Dragon consists of a chain of stars, partly surrounding the Little Bear; and between Cassiopeia and the Swan is the constellation Cepheus.

Near Algenib, and pointing directly towards it, are two stars of Andromeda, and a third is a little beyond them. A line drawn through the Great Bear and Capella passes to the Pleiades, and then turning at a right angle towards the Milky Way, reaches Aldebaran (α Tauri), or the Bull's eye, and the shoulder of Orion, who is known by his belt consisting of three stars placed in the middle of a quadrangle. Aldebaran, the Pleiades, and Algol make the upper points, Menkar (α Ceti), or the Whale's jaw, with Aries, the lower points of a W. In Aries we observe two principal stars, one of them with a smaller attendant.

A line from the pole, midway between the Great Bear and Capella, passes to Gemini (the Twins), and to Procyon; and then in order to reach Sirius it must bend across the Milky Way. Algol and the Twins point at Regulus (α Leonis), the Lion's heart, which is situated at one end of an arch, with Denebola (β Leonis) at the other end.

The Pole-star and the middle horse of the Bear direct us to Spica Virginis, considerably distant; the pole and the first horse, nearly to Arcturus in the Waggoner (Böotes). Much further southward, and towards the Milky Way, is Antares in the Scorpion; forming, with Arcturus and Spica as a base, a long triangle, within which are the two stars of Libra. The Northern Crown is nearly in a line between Vega (Lyra) and Arcturus; and the heads of Hercules and Serpentarius are between Lyra and Scorpio. In the Milky Way, below the part nearest to Lyra, and on a line drawn from Arcturus, through the head of Hercules, is Aquila, making, with Lyra and Cygnus, a conspicuous triangle. The last of the three principal stars in Andromeda make, with three of Pegasus, a square, of which one of the sides points to Fomalhaut, situated at a considerable distance in the southern Fish, and in the vicinity of the Whale, which has been already mentioned. By means of these supposititious lines all the principal stars that are ever visible in our climates may be easily recognized.

STAR, in heraldry, is a bearing of frequent occurrence, usually referring to a star proper, but sometimes representing the rowel of a spur, in which case the correct blazon for it is *Mullet*. Stars in heraldry have five points, and are straight-pointed unless blazoned as "wavy," or, which is synonymous, as "flaming."

STAR APPLE is the name given in the West Indies to the fruit of *Chrysophyllum cainito*, a species of plants belonging to the order SAPOTACEÆ. This species is a moderately-sized spreading tree, with very slender flexible branches, abounding in a sweet harmless milky juice,

which flows most copiously when the tree is beginning to mature its fruit. The under surface of the leaves is covered with golden hairs. The flowers grow in small purplish bunches, and are succeeded by a round fleshy smooth fruit, resembling a large apple. In the inside the fruit is divided into ten cells, each containing a black shining rhomboidal seed, and surrounded by a white or sometimes purplish gelatinous pulp, traversed with milky veins, and of a very sweet agreeable flavour. In an unripe state the taste is said to be astringent and unpleasant. When cut across, the seeds, which are regularly disposed round the axis of the fruit, present a stellate figure, from whence the name of star apple is derived. Some of the species of Chrysophyllum are cultivated in this country for the sake of their beautiful foliage.

STAR CHART. In the article STAR it is mentioned that calculations show not less than 50,000,000 stars to be visible in our hemisphere with such powerful modern instruments as the great Parsonstown reflector telescope. It is manifestly impossible by any maps which could be drawn, no matter what their scale or plan, to present anything even approaching a correct picture of the heavenly host. There is no way even of showing their numerical wealth in a single picture. Argelánder with a small telescope of 2¾ inches in aperture charted 324,198 stars, covering about to the ninth or tenth magnitude; and when these are put upon a large sheet of paper the points throng so closely that they almost cover the surface. A peculiar striated effect is observed upon the chart. This is due to the survey working in circles as the heavens swept round before its gaze. Consequently if a night were very clear, a rich ring of stars was charted round the North Pole, but if it were dull a far less rich ring was visible. Again, the telescope was shifted to a wider radius from the pole at each survey, but its field of vision being keener at the centre, every night's survey tended to produce a richer result along the medial line surveyed, with a poorer band on each side of it; for faint stars, just visible in the centre of the field, would not be visible at either edge.

To obviate all these objections it has lately been proposed to photograph the whole visible heavens direct from the sky. Such a work was actually begun in 1886 by the French observers, Paul and Prosper Henry, who found themselves able to photograph a space of 3 degrees by 2¼ degrees (say six times the apparent diameter of the moon by four and a half) in an hour. Three photographs of each space have been felt to be necessary, to avoid accidental dots upon the plate confusing the record. Seeing that this space is rather less than one-sixthousandth part of the whole heavens, it is evident that twelve widely scattered observatories, producing 510 photographs each, would accomplish the task. But probably only one plate could be satisfactorily taken *per noctem*, and there are only about fifty-one nights to be reckoned on as moonless and clear during a year; it results therefore that the whole work under such conditions would take about ten years. From 15,000,000 to 20,000,000 stars would be shown, as is easily calculated from the actual results obtained by MM. Paul and Prosper Henry. But the photographic process has developed a still more surprising capability. It is well known that when any object emits too faint a light to make a perceptible impression on the retina of the eye, continued gazing in its direction will not make it visible. That is, the effects of its faint light are not cumulative. But it is found that on a highly sensitive photographic plate, a prolonged exposure of many hours brings into view *on the plate* stars which to the human eye are wholly invisible, the plate thus becoming, as it were, a new and more sensitive retina. As these prolonged exposures tend to broaden out unduly the images of the visible stars, it is considered best to make a series of graduated exposures on the same part of the heavens. The stars which are sufficiently depicted by the shorter exposures—and all star images begin as mere points of light—are catalogued separately according to the *actinic power of their rays*, thus substituting for the division into *magnitudes*, which depends on the powers of comparison of the individual observer, a classification based upon a generally unchangeable characteristic of the stars themselves. The knowledge of the star-sphere thus gained must open up fields of astronomic research hitherto untouched. With accurate charts before them, the astronomers of to-day may again attack the problem of the constitution of the stellar universe, and may hope for better results than any yet attained.

STAR OF BETHLEHEM. See ORNITHOGALUM.

STAR OF INDIA. The most exalted order of the Star of India was founded by Queen Victoria in February, 1861, in order to afford to the princes, chiefs, soldiers, and civilians in the Indian Empire a testimony of royal regard, and a reward for loyal service. It has been remodelled in 1866, 1875, and 1876, and it now consists of the sovereign; a grand-master, who is the viceroy for the time being; thirty knights grand-commanders, or G.C.S.I.; seventy-two knights-commanders, or K.C.S.I.; and 144 companions, or C.S.I., together with such extra and honorary knights as the sovereign may appoint. Native and European officials are alike eligible for the order, and one of its recipients is a Mohammedan princess, the Begum of Bhopal. Its distinguishing costume is a light blue robe with a silver border, the insignia consisting of a jewel containing a medallion of the queen, surmounted by a five-pointed star, worn suspended by a gold collar. The motto is "Heaven's light our guide."

STAR THISTLE (*Centaurea Calcitrapa*) is a plant belonging to the order COMPOSITÆ and tribe Cynaroideæ. It occurs in gravelly and sandy places in England, but is rather local. The star thistle is an herb with a branched spreading stem, about a foot high, and lateral sessile heads of rose-purple flowers. An allied species is the Knapweed (*Centaurea scabiosa*), common in Britain in fields and hedges. It grows to a height of 2 or 3 feet, and has stalked heads of purple flowers. *Centaurea nigra*, also called knapweed, is common in pastures. Another common species of Centaurea is the Corn Blue-bottle (*Centaurea cyanus*), a tall herb found in cornfields, with pretty sky-blue flowers. When cultivated in gardens the flowers are found varying from white to every shade of blue and purple.

STAR'BOARD, the right-hand side of a ship or boat when a spectator stands with his face towards the head, stem, or prow. When the master of a ship gives an order to the helmsman to *starboard* it means to put the helm to the starboard side. The derivation of the word is often given as from the Italian *'sto bordo* (meaning *questo bordo*, on this side); larboard, the correlative term, coming from *'lo bordo* (*quello bordo*, that side). There is, however, much to be said for the other derivation more recently given by etymologists, which regards starboard as coming from the Old English *steor* (rudder), and as meaning therefore the steering-side, because a steersman usually holds the tiller in his right hand. In Alfred the Great's "Orosius" *steorbord* is opposed to *baecbord* (backward-side), which strongly supports this view when the attitude of the steersman is considered, and the latter survives in the French equivalent, *babord*.

The term *larboard*, uttered in like manner, would imply an order to put the helm to the larboard side; but as the words starboard and larboard are apt to be mistaken, from their resemblance in sound, it is usual to substitute the word *port* for larboard.

STARCH, called also *Farina* or *Fecula*, is a substance widely diffused throughout the vegetable kingdom, and found in almost every plant. It occurs in large quantities in the various seeds of corn, and is also found in the pith

and bark of many trees, and in the bulbs and tubers of many plants. It acts as the stored-up nutriment of the plant, and hence its value as a constituent of the seed, forming the first food of the young cotyledons. Starch occurs in plants in the form of *starch-grains*, which are small hard granules, generally round or oval, occurring either singly or in compound granules. In addition to containing water and a small quantity of mineral matter the starch-grain consists of two substances—*granulose*, which can be extracted by saliva or by dilute acids; and *starch-cellulose* or *farinose*, which then remains as the skeleton of the grain. The latter substance does not turn blue on treatment with iodine till after the addition of strong sulphuric acid. The formation of the starch-grain is dependent upon the presence of the green-colouring matter CHLOROPHYLL, which is present in all plants except fungi and other parasites. In the ordinary flowering plants chlorophyll is contained in protoplasmic bodies, occurring in abundance in the cells of the leaves. Within these chlorophyll corpuscles the starch-grains are formed in the presence of sunlight; and experiments prove that their formation is almost wholly dependent upon the red, orange, and yellow rays of the spectrum. If the cells containing the chlorophyll corpuscles be placed in the dark, the starch is absorbed and disappears from the corpuscles.

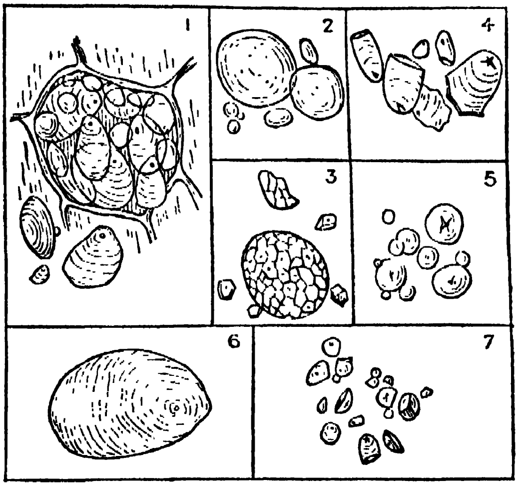
The mode in which starch-grains are formed and grow within the chlorophyll corpuscles is explained in two ways. The mature starch-grain is marked with concentric striations around a nucleus, the hilum. This appearance is thought to be due to the regular alternation of dense layers of starch-substance with more watery layers around the hilum, the layers increasing in density from within outwards. The growth is thought to be brought about by *intussusception*, that is, the intercalation of new particles of solid matter between those already existing. According to the second view starch is formed as one of the products of the decomposition of the protoplasm of the chlorophyll corpuscle, successive layers of starch-substance being deposited upon the primitive granule by the decomposition of successive layers of protoplasm.

The starch formed in the chlorophyll grains is redissolved after its formation, and conveyed in the form of a glucoside either to those parts of the plant where new cells are being formed or to some reservoir of nutrient materials, as seeds or tubers, where it is stored up in the form of starch again for future use.

The following table shows the proportion of starch present in certain well-known articles of food, expressed in parts per hundred:—

Wheat flour, . .	66	Indian corn flour,	77
Oats " . .	40	Pease, ...	38
Barley " . .	64	Haricot beans, .	37
Rye " . .	61	Potatoes. . . .	23

Starch usually presents the appearance of a white glistening powder, but when examined under a microscope it is found to consist of minute granules, which differ considerably in form and size, according to the source from which they are derived. The size varies from ·002 to ·185 millimetre. In the accompanying figure No. 1 shows the granules of potato starch as these appear in the cells of the tuber; No. 2, wheat starch; No. 3, oat starch; No. 5, maize or Indian corn starch; No. 4, sago starch, made from the pith of a palm tree, *Sagus lævis*, natural order Palmaceæ; No. 6, tous-les-mois starch, made from the *Canna edulis* of Peru, natural order Marantaceæ: the true Bermuda arrow-root is also a starch, obtained from the tubers of another plant belonging to the same order, Maranta Arundinacea; No. 7, tapioca starch, prepared from the roots of the Janipha Manihot of Brazil, natural order Euphorbiaceæ, the plant which also furnishes cassava bread. This plant, in common with many others which furnish edible starches, is poisonous. The last two figures show the great difference of the size of the granules, that of tous-les-mois being the largest, and that of tapioca one of the smallest. The granules of rice starch are, however, smaller still. These starches are scarcely distinguishable



from one another as they are found in commerce; and as the more expensive starches, such as arrow-root and tous-les-mois, are often adulterated with the cheaper varieties, such as those of rice and potatoes, the microscopic characteristics become an important means of detecting the adulteration.

The horse-chestnut is also employed as a source of starch, and some other starches were at one time much used in this country. Portland arrow-root was made in the island of Portland from the corms of *Arum maculatum*, the cuckoo-pint or "lords and ladies," natural order Araceæ. Salep, once much used by invalids, was obtained from the roots of the common *Orchis mascula*, natural order Orchidaceæ. East Indian arrow-root comes from the young tubers of the *Curcuma longa* or turmeric, natural order Zingiberaceæ.

Starch is an important manufacture, and is obtained on a large scale from several sources; those principally employed are potatoes, wheat, maize, and rice. When potatoes are used the tubers are simply rasped and washed in a stream of water on sieves. The milky fluid which passes through is allowed to stand, and the starch is deposited, and after being well washed it is dried in frames at a gentle heat. Wheat, maize, and rice are ground with water and a small proportion of caustic soda, which dissolves the gluten, and enables the starch to separate more completely. The milky fluid is run through coarse strainers and allowed to deposit. The starch is then thoroughly washed in cold water, again allowed to deposit, and dried in boxes at a gentle heat. When dry the cakes split up into the peculiar irregular forms so well known. It is perfectly white when pure, but it is usual to give it a faint blue tinge by the addition of a minute proportion of indigo. The specific gravity of starch is 1·505; the formula is $C_6H_{10}O_5$. As met with in commerce it usually contains from 12 to 18 per cent. of water. Starch is insoluble in cold water, and also in alcohol. With hot water it forms a gelatinous mass known as starch-paste, in which form it is employed for stiffening fabrics, but it is not an actual solution. When boiled with water under pressure at about 150° C. (302° Fahr.), it is obtained in a solution, which deposits on cooling an altered starch called soluble starch. This is

slightly soluble in cold water, and completely soluble when the water is heated to 70° C. (158° Fahr.) It is also produced from starch by the action of diastase, by the action of strong sulphuric acid in the cold, or by boiling with very dilute sulphuric acid. It resembles dextrin, but is distinguished from it by forming a blue colour with iodine. Starch when heated to 160° C. (320° Fahr.), is converted into dextrin; commercial dextrin is generally prepared in this way. Starch is also converted into dextrin and glucose by diastase, and by the saliva and the pancreatic juice, and in this way is digested as a food, and enters into the blood. The same change is effected by concentrated sulphuric acid in the cold, and by boiling with very dilute hydrochloric or sulphuric acids.

Concentrated nitric acid dissolves starch and forms a nitro-compound called nitramidin, $C_6H_9(NO_2)O_5$, which is precipitated from solution by water as a white powder resembling xyloidin. If the nitric acid be mixed with concentrated sulphuric acid the product formed is di-nitramidin, $C_6H_8(NO_2)_2O_5$, an explosive compound. Hot dilute nitric acid converts starch into oxalic acid. Starch forms insoluble compounds with baryta and lime, called barium and calcium amilates, and with lead, plumbic amilate, which has the formula $C_{12}H_{18}PbO_{10}PbO$. A solution of iodine forms a deep blue compound with starch, which is decolourized by heating. Iodine forms an extremely sensitive test for starch, the presence of which in any part of a plant may be at once detected by moistening it with a drop of tincture of iodine; the smallest trace of starch gives immediately an intense blue colour with this reagent. The quantity is usually estimated by converting it into glucose, and titrating the glucose by an alkaline cupric solution. Iodized starch is used in medicine as a mild form of administering iodine.

Pure starch has no taste nor odour; it forms a large part of bread and many other cereal foods. It is extensively employed in the manufacture of glucose and dextrin, both of which are products of considerable commercial importance. It is also largely used in the dressing of cotton and linen goods, and also for thickening colours in calico printing. It is used in making cocoa, chocolate, and lozenges; and also in medicine as a demulcent. The relative value of starches may be estimated by observing the weight required to sink a flat disc of metal into the starch jelly prepared from the starches to be tested.

STAR-CHAMBER. The Star-Chamber is said to have been in early times one of the apartments of the king's palace at Westminster which was used for the despatch of public business. The Painted Chamber, the White Chamber, and the Chambre Markolph were occupied by the triers and receivers of petitions, and the king's council held its sittings in the Camera Stellata or Chambre des Estoylles, so called from the *starra* or Jewish covenants which were deposited there by Richard I. The dog-Latin translation (*camera stellata*) of the chamber's name led to the piece of folk-etymology which asserted the roof of the chamber to have been painted with stars, a statement for which there is absolutely no foundation.

The judicature of the court of Star-Chamber originated in the exercise of a criminal and civil jurisdiction by the King's Council, or by that section of it which Lord Hale calls the Concilium Ordinarium, in order to distinguish it from the Privy Council, the members of which were the deliberate advisers of the crown. The exercise of jurisdiction by the King's Council was considered as an encroachment upon the common law, and being the subject of frequent complaint by the Commons, was greatly abridged by several Acts of Parliament in the reign of Edward III. It was discouraged also by the common law judges, although they were usually members of the council; and from the joint operation of these and some other causes, the power of the Concilium Regis as a court of justice had materially declined previous to the reign of Henry VII. A court which was enacted by statute of the 3 Henry VII. c. 1, was probably not the Court of Star-Chamber, for it seems that this court by statute fell into disuse after the middle of the reign of Henry VIII.; that the Court of Star-Chamber was the old Concilium Ordinarium, against whose jurisdiction many statutes had been enacted from the time of Edward III., and that no part of the jurisdiction exercised by it could be maintained on the authority of the statute of Henry VII. At the beginning of the reign of Elizabeth the court was unquestionably in full operation, in the form in which it was known in the succeeding reigns; and at this period, before it had degenerated into a mere engine of state, it was by no means destitute of utility. It was the only court in which great and powerful offenders had no means of setting at defiance the administration of justice or corrupting its course. And during the reign of Elizabeth, when its jurisdiction had reached its maturity, it seems, except in political cases, to have been administered with wisdom and discretion.

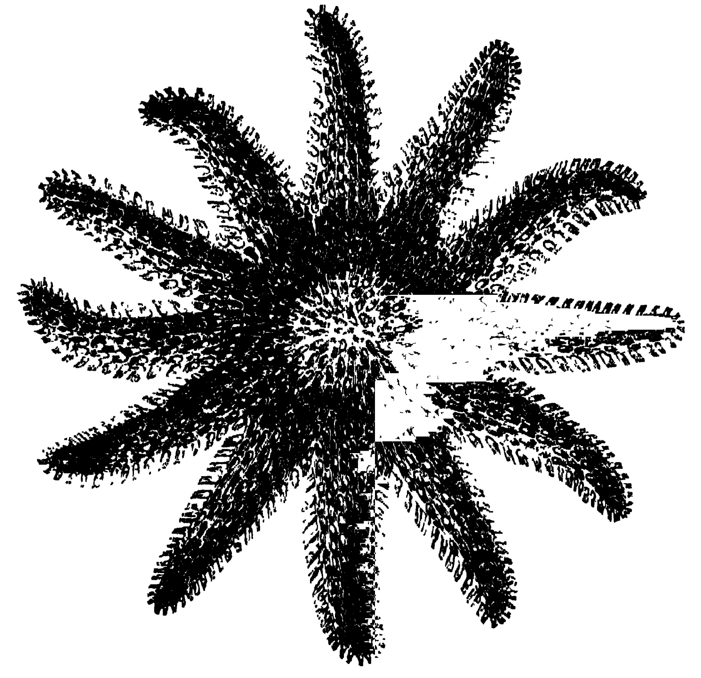
The proceedings in this court were by information, or bill and answer. Interrogatories in writing were also exhibited to the defendant and witnesses, which were answered on oath. The attorney-general had the power of exhibiting *ex-officio* informations. In cases of confessions by accused persons the information and proceedings were oral; and hence arose one of the most oppressive abuses of the court in political prosecutions. The proceeding by written information and interrogatories was tedious and troublesome, often involving much nicety in pleading, and always requiring a degree of precision in setting forth the accusation, which was embarrassing in a state prosecution. During the last century of its existence, enormous fines, imprisonments for life or during the king's pleasure, banishment, mutilation, and every variety of punishment short of death, were often inflicted by a court composed of members of the King's Council, upon a mere oral proceeding, without hearing the accused, without a written charge or record of any kind, and without appeal. What seems still worse is the frequent application of torture to obtain confessions of guilt or complicity; and the fact, repeatedly proved, that admissions of the most innocent character were twisted into formal confessions by mere word-juggling when the offender's fate had been resolved upon.

Its civil jurisdiction comprehended mercantile controversies between English and foreign merchants, testamentary causes, and differences between the heads and commonalty of corporations, both lay and spiritual. Its criminal jurisdiction was very extensive. If the king chose to remit the capital punishment, it had power to punish as crimes even treason, murder, and felony. Under the comprehensive name of contempt of the king's authority, all offences against the state were included. Forgery, perjury, riots, maintenance, embracery, fraud, libels, conspiracy, and false accusation, misconduct by judges, justices of the peace, sheriffs, jurors, and other persons connected with the administration of justice, were all punishable in the Star-Chamber.

A measure which was introduced into the House of Commons in the last Parliament of Charles I., to limit the authority of this court, terminated in its entire abolition. ("The Star-Chamber; Notices of the Court and its Proceedings," by John Southerden Burns: London, 1870).

STAR-FISHES (Asteroidea) is a group of ECHINODERMATA, forming with the order OPHIUROIDEA the class STELLERIDA. The star-fishes have a depressed pentagonal or star-shaped body; in the latter case there is a central disc extended into five or more arms or rays. The dorsal surface is covered with a tough leathery skin, in which are embedded calcareous plates, some of which bear projecting spines and processes. On the ventral or oral surface, extending along the arms, there is a movable

internal skeleton, consisting of calcareous masses (ambulacral ossicles) connected together like vertebræ. The mouth is placed in the centre of the ventral surface in a pentagonal or star-shaped depression, the edges of which are beset with spines. From the mouth proceeds a deep (ambulacral) groove to the ends of the arms, within which are two or four rows of tube-feet or ambulacra, which are the chief organs of locomotion; they are contractile sacs, generally provided with suckers at the tips. The water-vascular or ambulacral system, of which the tube-feet form a part, consists of a circular vessel surrounding the œsophagus, and of five radial vessels running into the arms, and giving off lateral branches to the tube-feet. These vessels have ciliated internal walls and contain a watery fluid, which, being forced into the tube-feet, causes them to project through the pores between the ambulacral ossicles; the tube-feet then, fixing themselves by their terminal suckers to any object, contract and so draw the body slowly along. The water filling these vessels enters through a porous calcareous (madreporic) plate on



Solaster papposus

the dorsal surface, and runs through a canal (called the stone-canal from the calcareous deposits in its walls) to the circular water-vessel. This latter is provided with large pear-shaped cæca, the Polian vesicles, in which the water collects, and by their contraction is forced into the radial vessels. The lateral branches of the radial vessels in like manner are provided with contractile sacs or ampullæ, which drive the water into the tube-feet. In this way the water circulating in these vessels enables the animal to move in the direction of any one of the arms.

The mouth leads, by a short œsophagus, into a very wide stomach occupying the middle of the body, and sometimes ending blindly; it is provided with five pairs of cæca, which extend into the five arms; the alimentary canal is usually continued into a short tubular rectum opening by a minute anal pore on the dorsal surface of the body. The rectum gives off five short interradial cæca, which aresupposed to function as kidneys.

Respiration is carried on mainly by the water-vascular system, which brings about an exchange of gases by means of the water which circulates within the vessels. Star-fishes have also, however, special branchiæ, thin-walled tubular processes of the dorsal integument, which are ciliated internally and are in communication with the body-cavity.

They possess a well-developed blood-vascular system consisting of a circular vessel surrounding the mouth, from which radial trunks proceed beneath the radial water-vessels, and send minute branches to the tube-feet. There is also beneath the dorsal surface another circular vessel, which gives off branches to the stomach and generative organs, and communicates with the oral circular vessel. The blood is clear, and contains colourless corpuscles.

The nervous system also partakes of the radial arrangement. There are five radial nerve-trunks situated outside the radial bloodvessels, which unite to form a nerve-ring round the mouth.

Tentacle-like tube-feet, without suckers, are present at the tips of the arms, and these are considered to function as organs of touch. At the tip of each arm is also a red pigment-spot which serves as an eye.

On the dorsal surface of the body are scattered peculiarly modified spines, known as pedicellariæ. These consist of a flexible muscular stalk terminating in two or three pincer-like calcareous valves, which are continually snapping together. They probably act as cleansing organs, like the avicularia of the Polyzoa.

Reproduction in the star-fishes is sexual, and the sexes are distinct. There are five pairs of generative glands extending for some distance into the arms, and opening to the exterior by pores on the dorsal surface, generally in the angles between the arms.

Development from the egg takes place by a complicated process of metamorphosis. The young star-fish is hatched as a pear-shaped ciliated larva, provided with a mouth, alimentary canal, and anus. The ciliated band encircling the mouth becomes divided, and forms a ring in front of, and a ring behind the mouth. In this stage the larva is known as Bipinnaria. Slender movable arms now appear near the mouth, which assist in locomotion, and rudiments of the water-vascular system are formed. The anterior portion of this larva, which is known as Brachiolaria, ceases to grow, and at its anal extremity the disc of the star-fish begins to develop till gradually the arms and the rest of the larval body wither up and disappear.

In addition to this sexual method of reproduction, star-fishes have also such a power of reproducing lost parts as almost to amount to reproduction by fission. Not only can a lost arm be reproduced, but a single arm can develop into a new star-fish.

Star-fishes feed on molluscs, crustaceans, worms, and other marine animals. The destruction they cause among oysters is enormous. The star fish encircles the oyster within its arms, and protrudes its stomach through its dilatable mouth between the valves of the oyster-shell. When the oyster is seized the stomach of the star-fish can be completely inverted over its victim's body. To compensate for this devastation among oysters, mussels, and other useful shell-fish, star-fishes are most efficient

scavengers, devouring all kinds of garbage which would otherwise accumulate on the sea-shore. Star-fishes are not used as food, but in many places are highly esteemed as manure.

The order Asteroidea is divided into four families. The family Asteriadæ (Plate I., fig. 1) contains the common star-fish of our coasts (*Asteracanthion* or *Asterias rubens*), also called the Cross-fish, Five-fingers, Five-fingered Jack, or Devil's Fingers. The family Solasteridæ contains the sun-stars, a species of which, the Rosy Sun-star (*Solaster pap-posus*), is figured in the type; this family is distinguished from the preceding by having only two, instead of four, rows of tube-feet. The family Astropectenidæ (fig. 2) has only two rows of tube-feet and no arms. The family Brisingidæ has the arms more or less distinct from the disc, thus approaching the order Ophiuroidea.

In the Plates are also figured (figs. 3 to 7) species of the order OPHIUROIDEA, which differs chiefly from the typical star-fishes in having the arms sharply distinguished from the disc, and not containing appendages of the alimentary canal, in having no suckers to the tube-feet, and in the ambulacral groove being covered by rows of calcareous plates.

STAR-GAZER (Uranoscopus) is a singular genus of fishes belonging to the family Trachinidæ (Weevers). The name refers to the position of the eyes on the upper surface of the head; these organs are very small, directed upwards, and can be raised or depressed at the will of the fish. The head is large, broad, and thick, defended with bony plates. The body is either naked or partially or entirely covered with very small scales. There are two dorsal fins; the ventral fins are placed beneath the throat, and the pectorals are large, with branching rays. These fishes lie hidden on the sea-bottom, buried in the sand or between stones, and catch their prey by means of a singular fishing-rod, a long delicate filament attached to the bottom of their mouth, which, swaying to and fro with the current, lures small animals into the fish's jaws. They are small fishes, rarely exceeding a foot in length. Eleven species are known, from the Indo-Pacific and Atlantic. One, *Uranoscopus scaber*, occurs in the Mediterranean and off the Canary Islands. It is about a foot long, grayish-brown above and grayish-white with white spots below. It was well known to the ancients, and was described by Aristotle.

STARLIGHT. It is a common delusion to think that on moonless nights the faint light by which we can distinguish much of the landscape comes from the stars. We know from a careful calculation made by Sir John Herschel, based upon the light of α Centauri, that a cluster of 27,408 stars of the first magnitude would be required to give the light of the full moon. There are never more than 1600 stars visible to the naked eye on a dark night, and of these not more than four would be at all likely to be of the first magnitude. Now, stars of the second magnitude are much less than half as bright as those of the first; stars of the third magnitude are only a sixth as bright, those of the fourth magnitude only a sixteenth as bright, those of the fifth only a fortieth, those of the sixth only a hundredth as bright as those of the first magnitude. Therefore it is evidently absurd to suppose that any such amount of light can come from the stars as to enable us to dimly distinguish terrestrial objects. No well-supported theory of "starlight" has yet been propounded. Retained luminosity (as with luminous paints) has been suggested; others look rather to the reflection of light along vast distances of air from illuminated regions of the earth. It appears to be almost certain that the air is in some way the true cause of the so-called "starlight."

STAR'LING (Sturnus) is a genus of passerine birds belonging to the family Sturnidæ. The starlings have a long, straight, compressed bill, long and pointed wings, of which the first primary is short, and a short and nearly even tail; the tarsi are of moderate length, stout, and covered in front with broad scales; the toes, especially the hind toe, are long and tolerably powerful, and the outer toe is united at the base to the middle one; the claws are short and moderately curved.

The Common Starling (*Sturnus vulgaris*) is distributed over the whole of the continent of Europe, and occurs abundantly in almost every part of the British Isles. It extends to Egypt, Asia Minor, Persia, and India. In Southern Europe it is known generally as a winter visitor, its place as a resident being taken by the nearly allied *Sturnus unicolor*. It is a handsome bird, its black plumage exhibiting tints of purple and green, according to the direction in which the light falls upon it, and being also adorned with numerous spots and streaks of buff and pale reddish-brown. The female is less brilliantly coloured, and the young bird is brownish-gray. The total length is about 8½ inches. In the autumn the starlings collect into large flocks, consisting of old and young birds, which fly together in search of food and roost together at night. Their food consists of worms, snails, insects, and of berries and seeds. The damage done in orchards among cherries, &c., is amply compensated for by the large number of noxious insect-larvæ which these birds destroy. The flight is rapid and even; and bodies of them are often observed in the summer performing extraordinary evolutions in mid-air before going to roost. The note is a shrill whistle. The starling possesses considerable power of imitating the notes of other birds. The nest is made of dried grass, twigs, &c., and built in holes of buildings or rocks, or in a hollow tree. The eggs are four to seven in number, and of a beautiful pale blue colour.

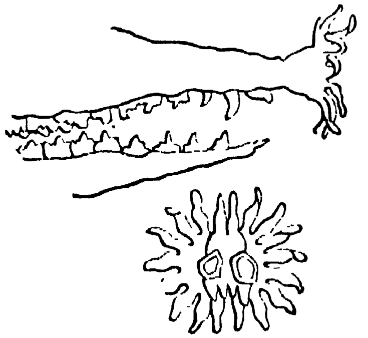
In confinement the starling is an intelligent, docile, and sprightly bird. He may be taught many tricks, and exhibits a good deal of resemblance to some of the crows in his disposition. He will learn to whistle short tunes, and even to repeat a few words, although, notwithstanding the celebrity he has acquired in this respect from Sterne's well-known story, his power of imitating the human voice is far inferior to that of the raven or the magpie.

The genus Pastor, of which there are about a dozen species from Asia and Africa, is nearly allied to the true starlings. The Rose-coloured Starling (*Pastor roseus*) is an irregular summer visitor to Britain, breeding in Southern Europe and Asia Minor. It is a beautiful bird, the head, neck, wings, and tail being black, glossed with various shades of blue and green, and the back and the whole of the lower surface, except the throat, which is purplish-black, being rose-pink. It is about 8½ inches long. In its habits it resembles the common starling. The GRAKLES (Gracula) and BEEF-EATERS (Buphaga) also belong to the family Sturnidæ.

STAR-NOSE or **STAR-NOSED MOLE** (*Condylura cristata*) is a remarkable species of MOLE (Talpidæ), a native of North America from South Carolina to Hudson Bay. The star-nose is so called from the curious structure of the snout, which is prolonged into a narrow proboscis, the naked extremity of which is provided with a fringe of about twenty long, movable, fleshy processes, forming a regular star; the nostrils are placed towards the centre of this disc. The star-nose is about 5 inches long, exclusive of the tail, which measures 3 inches. The body resembles that of the mole in general appearance, but the fore part is stouter in proportion to the hinder. The legs are short, especially the hind pair, and the feet have five short toes each, fitted for digging. The eyes are very small, and there are no external ears. The body is covered with a thick, soft, fine fur, dark amber-brown above, paler below. The proboscis and feet are flesh-coloured.

The star-nose inhabits swampy places or the vicinity of water. Like the common mole it lives in burrows exca-

vated beneath the surface of the ground. It feeds on worms and the larvæ of insects, in the capture of which the



Snout of the Star-nose.

curious appendages of the nose probably aid as organs of touch.

START POINT, a well-known rocky promontory in the south of Devonshire, 204 feet in height. It is the last seen by outward-bound ships leaving the Channel, and is crowned by a handsome lighthouse. The word Start is from the Anglo-Saxon *steort*, a tail or promontory.

STARVA'TION, the general term for that weakening of the animal body which occurs from deprivation of food. The great feature of starvation is the loss of flesh, which may be well tested by the diminution of weight. As might be expected, this loss is most rapid at first, but soon gets into a fairly steady daily rate, and a large number of experiments go to show that death ensues when the body has sunk to three-fifths of its original weight. But this loss is borne very differently by the different tissues. Thus, while in the starved animal the nervous system is found to have lost scarcely anything, no less than 97 per cent. of the fat has disappeared. Between these extremes we find that the liver loses 56 per cent., ordinary muscles 30, the heart very little, the skin 33, the blood 17, the bones 16, the eyes 10.

Upon these figures we see at once the truth of the epigram that "death by starvation is death by cold," and of the popular phrase in winter, "starved with cold." The fat is nearly all consumed in the desperate effort to keep up the animal heat. The average temperature diminishes from the first, but what is more remarkable is its great variation. It sinks and then suddenly rises, as if the body were rallying its forces to fight the enemy. Just before death these rallies cease, and the descent of the temperature is rapid, death occurring when about 60° Fahr. is reached. Consequently with starving animals (or men) warmth is the first restorative which should be applied. It is only after the sufferer has been warmed artificially that it can begin to digest food and create warmth for itself from within.

The pains of starvation, as recorded by human sufferers, are—first, hunger, passing into pangs in the region of the stomach; then the terrible torture of insatiable thirst; sleeplessness soon occurs, and emaciation marks the beginning of the end. The close of life is frequently accompanied by delirium or convulsions. A dreadful odour hangs about starving people; and, indeed, in all badly nourished persons somewhat of the same sort is less markedly observable. If food be absolutely wanting starvation leads to death in about six days, or at the outside ten. But if water is procurable a very long fast is endurable without eating. An exceedingly small quantity of food will suffice to stave off death if water is plentiful, and every physician constantly warns his patients that they eat far too much in general life. Of course a more generous diet is necessary than that amount which merely suffices to keep one alive, but yet this last seems so incredibly small when the subject is first investigated, that the student is sure to be impressed with the enormous waste he and others are daily committing. The cases of voluntarily fasting men or women are usually mere tricks to gain money or notoriety; there are, however, numerous well-authenticated cases of absolute fasting from food for several weeks, when water has been freely supplied, and that without damage to the subsequent health of the experimenter.

The fatty cushion of the eyeball is among the first parts to diminish perceptibly; the brain is always the last part to be touched, and is still usually almost perfect when death by starvation has occurred. The intestines become so thin as to be transparent, and are quite empty, as is also the stomach. The bile remains plentiful; all the other secretions are absent. The tissues, which throughout starvation are more watery than in health, decompose rapidly after death.

STA'TEN ISLAND, a hilly island forming the west boundary of the Narrows of New York Harbour, 6 miles south-west of the city, 14 miles long by 4 to 8 broad. The north portion forms a rounded eminence, 307 feet high, covered with splendid mansions, and the scenery of the island is beautiful. There are steam ferries to the city.

STATE-PAPER OFFICE was founded in 1578. The British government commenced in 1857, under the direction of Sir John Romilly, the publication of calendars of the valuable papers preserved here, much to the assistance of the historical student. See RECORD OFFICE.

STA'TER, which really means standard, was the name given to the standard gold coin of Greece first stamped by Kroisos (Crœsus) of Lydia. The gold stater is considered to have been worth £1 3*s*. 4*d*. in Alexander's time. It was worth twenty silver drachmas, and silver was then not so cheap as it now is. There was also a silver stater, more properly called *tetradrachm* [see DRACHMA], which was worth 3*s*. 3*d*.

STATES-GENERAL. This term is from the French *États Généraux*, the assembly of the three orders of the kingdom—the clergy, the nobility, and the third estate. The States-General of France were first assembled in 1302; again convoked in 1614 under Louis XIII., after which they did not meet until 1785.

The memorable Convocation of the States-General of France of 1789 led to the Revolution. A dispute arose between the two privileged orders and the third estate (*tiers état*) about their mode of sitting and voting; and finally (17th June, 1789) the deputies of the *tiers état*, with such deputies of the clergy as chose to join them, for none of the nobles accepted the invitation, assumed the name of the National Assembly.

Louis XVI. afterwards sanctioned the union of the three estates in the National Assembly, one of whose early acts was the publication of the "Declaration of the Rights of the Man and the Citizen." The National Assembly continued its labours several months after the death of Mirabeau, 2nd April, 1791. In September, 1791, the Assembly presented to the king for his sanction the new constitution, which he accepted, and the Assembly dissolved itself on the 30th of the same month.

STA'TICE is a genus of plants belonging to the order PLUMBAGINEÆ. The species are numerous, inhabiting chiefly salt marshes and the shores of temperate seas; they are natives of Southern and Eastern Europe, the Canary Islands, and Central Asia. Several species are natives of Britain, where they are known as Sea Lavenders. The exotic species are cultivated in gardens and greenhouses. They are herbs or undershrubs, with the flowers in spikes or panicles. The calyx is funnel-shaped, five-cleft, scari-

ous above; the corolla is five-parted; the fruit is a one-seeded nut, inclosed in the calyx. The Common Sea Lavender (*Statice Limonium*) is found in muddy salt marshes in England and Scotland. It is a foot or a foot and a half high, with dense spikes of bluish-purple flowers. The root possesses astringent qualities. *Statice occidentalis*, with blue flowers, is found on rocky shores in Britain. *Statice Caroliniana* is a native of North America, where it is called the Marsh Rosemary. The root is a very powerful astringent, and is used as an application in affections of the mouth and jaws.

STAT'ICS, a subdivision of mechanics, meaning the part of the science in which equilibrating forces are considered, in opposition to dynamics, in which the effects of forces producing motion are investigated: it is subdivided into the statics of rigid and of fluid bodies, the latter being called hydrostatics.

Statics, like all other mechanical sciences, is usually placed among mixed mathematics. But the line which separates it from the pure sciences is almost imperceptible, and it would seem more reasonable to invent a third and intermediate distinctive term than to place statics and electricity under the same name, to distinguish them from geometry.

STATIONARY, in astronomy. All the planets appear at the earth to move alternately forwards and backwards in the heavens, the retrograde motion not continuing so long as the direct motion. For a little time at the beginning and end of the retrogression the planet appears to have no motion. This arises when the relative motion of the planet is really towards the earth.

STATIONERS' HALL and **STATIONERS' COMPANY.** The hall is situated at the north end of Ave-Maria Lane, in the court leading from Paternoster Row into Ludgate Street. Maitland, in his "History and Survey of London," describes it as "a great house built of stone and timber, of old time pertaining to John, duke of Britain, earl of Richmond, as appeareth by the Records of Edward III. Since then it was Pembroke's Inn, near unto Ludgate, as belonging unto the Earls of Pembroke in the time of Richard II., the eighteenth year, and of Henry VI., in the fourteenth year. It was afterwards called Bugavenny House, and belonged to Henry, late lord of Bugavenny." It has long been held by the wealthy company whose name it takes. We have a record of the incorporation of its present possessors by letters patent of the 3 & 4 Philip & Mary, 1557. They were so incorporated by the title of "The Master and Keepers, or Wardens and Commonalty of the Mystery and Art of Stationers of the city of London." They are governed by a master, two wardens, and twenty-seven assistants, with a livery of 208 members, who, when admitted, pay a fine of £20. They are composed of stationers, booksellers, letterfounders, printers, and bookbinders.

In Maitland's "Survey," published more than 100 years ago, the Stationers' Company is represented as being possessed of "a stock of about £15,000, denominated the English stock, which is employed in printing almanacs, A B C's, primmers, psalters, school books, and privileged ware, the sole printing whereof is confirmed to them by letters patent of divers kings. This stock consists of nineteen whole shares of £320 each, which are generally possessed by those who are of the court of assistants. The second are thirty-eight half shares of £160 each. The third are forty-eight quarter shares of £80 each. The fourth are fifty-six half-quarter shares of £40 each: all which are divided among such as have fined for or served renter warden. Divers of the last-mentioned are divided into £40 shares for the obliging of a great number of members. Upon the death of any of the married possessors of this stock, the profits arising from his share devolve upon his widow, which she enjoys during her widowhood or life. At the expiration of either, another person is chosen to enjoy the profits of the said share; to which he is no sooner elected than he pays the deposit money to the late widow, her husband, or executor. The dividends upon the stock are made at Christmas, which are increased or decreased according to the experience of the preceding year; however, it is seldom less than £40 upon a whole share: a fine interest upon £320! The master and wardens of the company are always in the direction of the stock; to them are joined six other members annually elected, who adjust all accounts relating thereto, and at Christmas report the state thereof to the Board, who regulate the dividends already mentioned accordingly. This company has also a share in the Irish estate, and other considerable estates."

The Stationers' Company grew very rapidly after the accession of Queen Elizabeth. In 1575 it numbered 175 members, of whom 140 came to their freedom in her reign. It is, however, one of the oldest in London, and was clearly in existence before the art of printing was even invented. Stowe says:—"The first of this corporation which I have met with who practised the art of printing books were Wynkyn de Worde, a Dutchman, as it seems, who dwelt at the Sun in Fleet Street, and one Pynson, who both flourished in the reign of Henry VII., and in the beginning of the reign of Henry VIII.; and Thomas Godfrey, who printed a treatise writ by St. Germain in the time of King Henry VIII., concerning Constitutions Provincial and Legatine."

The company has largely flourished under the patronage of successive sovereigns, who, giving them special powers and unusual privileges, in return constantly used them as an instrument to enforce laws against free trade in literature. For instance, the Star-Chamber, on the 29th June, 1566, made a law, to the violation of which heavy penalties were attached, against the importation or printing of "any Booke or Copie against the Forme and meaning of any Ordinance, Prohibition, and Commandement, conteyned, or to be conteyned, in any Statutes or Lawes of this Realme, or in any Injunctions, Letters Patent, or Ordinances passed or set forth, or to be passed or set forth, by the Queen's Most Excellent Majestie's grant, commission, or authoritie;" and directed that the Stationers' Company should search wherever they might reasonably expect such works to be, and seize the same, taking the books to their hall, and "the parties therein offending" before the courts. And in the fourteenth year of the reign of Charles II. it was enacted that "none within London or the liberties thereof shall erect a press or printing-house, or knowingly demise, or suffer to be used, any house or room for a place to print in, unless he first give notice to the Master or Wardens of the Company of Stationers. No person shall make any printing press, no smith shall forge iron work for a printing press, nor no founder cast letters, nor shall any person import any letters cast, nor buy any such letters, printing presses, or other materials for printing, unless he first acquaint the said Master and Wardens, or one of them, for whom the same are to be made, cast, or imported, on pain to forfeit £5 for every offence, one moiety to the king, the other to him that will sue for the same." It was also provided that while no ordinary master printer should be permitted "to use above two printing presses at once," any master printer who had "been Master or Upper Warden of the Company" should be allowed to keep three; and the same favoured individuals were authorized to employ three apprentices, while their liverymen were only permitted two, and other persons one.

Very early in the history of the company it would seem to have become a custom to enter on its register the title of any projected or existing publication. In a volume of extracts taken from this register, and published by the Shakespeare Society, there occurs the following entry, dated as far back as 1557:—

"The entrynge of all such copies as be licensed to be prynted by the Mr. and Wardyns of the Mystery of Stacioners as followethe, that is to saye,—To Willm. Pekeryngo a ballet called A Ryse and Wake iii Jd. 1557.8."

This registration has been the subject of parliamentary enactments on various subsequent occasions. The 14 Chas. II. c. 33 enacts "that no private person shall print, or cause to be printed, any book or pamphlet, unless the same be entered in the Book of the Register of the Company of Stationers, except Acts of Parliament, proclamations, and bookes appointed to be printed by warrant under the king's sign-manual, or the hand of a secretary of state," &c.

Time has shorn the stationers of the arbitrary powers, the monopoly, and the unjust privileges which they once possessed, but it has reserved to them and enlarged their useful functions as registrars of copyrights.

By the eleventh section of an Act passed in the 5 & 6 Vict. c. 45, and commonly called Talfourd's Act, it is enacted that at the hall of the Stationers' Company there shall be kept a book of registry, wherein may be registered "the proprietorship in the copyright of books, and assignments thereof, and in dramatic and musical pieces, whether in manuscript or otherwise; and licenses affecting such copyright shall be kept at the hall of the Stationers' Company, by the officer appointed by the said company for the purposes of the Act, and shall at all convenient times be open to the inspection of any person on payment of one shilling for every entry which shall be searched for or inspected in the said book." The officer, whenever "reasonably required," shall, on payment to him of 5*s.*, give a copy of the same under the seal of the company. "Such copy so certified and confirmed shall be evidence in all courts and in all summary proceedings." The thirteenth section provides that, on payment of 5*s.*, entries shall be made on the register of the proprietorship in the copyright of any work which has been, or is intended to be published, "the time of the first publication thereof, the name and place of abode of the publisher thereof, and the name and place of abode of the proprietor of the copyright of the said book, or of any portion of such copyright." Every registered proprietor has also the power "to assign his interest, or any portion of his interest therein, by making entry in the said book of registry of such assignment, and of the name and place of abode of the assignee thereof," on "payment of the like sum." This "assignment so entered shall be effectual in law to all intents and purposes whatsoever, without being subject to any stamp or duty, and shall be of the same force and effect as if such assignment had been made by deed."

False entries are provided against in the twelfth section, which enacts "that if any person shall wilfully make, or cause to be made, any false entry in the registry book of the Stationers' Company, or shall wilfully produce, or cause to be tendered in evidence, any paper falsely purporting to be a copy of any entry in the said book, he shall be guilty of an indictable misdemeanour, and shall be punished accordingly."

To prevent injury being done to any person by reason of unfair entries being made "under colour of this Act," the fourteenth section provides that it shall be lawful for any person who deems himself aggrieved herein, to "apply by motion to the Court of Queen's Bench, Court of Common Pleas, or Court of Exchequer, in term time, or to apply by summons to any judge of either of such courts in vacation, for an order that such entry may be expunged or varied;" and the court or judge having made any order in the matter, "the officer appointed by the Stationers' Company for the purposes of this Act shall, on the production to him of any such order," comply with the instructions contained in the same. (All the above law-courts are now amalgamated.)

The eighth section of the Act gives the Stationers' Company power to demand "a copy of the whole of every book, and of any second or subsequent edition of any book containing additions and alterations, together with all maps and prints belonging thereto, which, after the passing of this Act, shall be published," for the use of the following libraries:—The Bodleian, at Oxford; The Public Library, at Cambridge; The Faculty of Advocates, Edinburgh; Trinity College, Dublin. The demand may be made at any time during twelve months after publication, and is to be complied with within one month. The officer of the company is to deliver the same to the library in one month, and is required to give a receipt to the sender. The publisher may, if he choose, forward what has been demanded direct to the library for which it has been required. If the publisher do not comply, he is to be held liable for the value of the book, and to a penalty not exceeding £5, which may "be recovered by the librarian or other officer (properly authorized) of the library for the use whereof such copy should have been delivered."

The International Copyright Act also contains provisions in reference to Stationers' Hall. That Act makes it lawful for her Majesty, by any order in council, to direct that, as respects all or any particular class or classes of the following works, viz., books, prints, articles of sculpture, and other works of art (to be defined in such order), which shall, after a future time (to be specified in such order), be first published in any foreign country (to be named in such order), the authors, inventors, designers, engravers, and makers thereof respectively shall have the privilege of copyright therein during such period as shall be defined in such order, not exceeding, however, as to any of these works, the usual copyright term. It is necessary, however, that whatever may be the subject of such order under which the benefits of the Act are to be claimed, "it shall be entered in the register book of the Company of Stationers in London;" and as regards books, musical compositions, &c., it is enacted that "one printed copy of the whole of such book, and of such dramatic piece or musical composition, in the event of the same having been printed, and of every volume thereof, upon the best paper upon which the largest number of impressions of the book, dramatic piece, or musical composition shall have been printed for sale, together with all maps and prints relating thereto, shall be delivered to the officer of the Company of Stationers at the hall of the said company; and as regards dramatic pieces and musical compositions in manuscript, the title to the same, the name and place of abode of the author and composer thereof, the name and place of abode of the proprietor of the right of representing or performing the same, and the time and place of the first representation or performance thereof in the country named in the order in council under which the benefit of the Act shall be claimed, shall be entered in the said register book of the said Company of Stationers in London; and as regards prints, the title thereof, the name and place of abode of the inventor, designer, or engraver thereof, the name of the proprietor of the copyright therein, and the time and place of the first publication thereof in the foreign country named in the order in council under which the benefits of the Act shall be claimed, shall be entered in the said register book of the said Company of Stationers in London, and a copy of such print upon the best paper upon which the largest number of impressions of the print shall have been printed for sale, shall be delivered to the officer of the Company of Stationers at the hall of the said company; and as regards any such article of sculpture, or any such other work of art as aforesaid, a descriptive title thereof, the name and place of abode of the maker thereof, the name of the proprietor of the copyright therein, and the time and place of its first publication in the foreign country named in the order in council under which the benefit of this Act shall

be claimed, shall be entered in the said register book of the said Company of Stationers in London, and the officer of the said Company of Stationers receiving such copies so to be delivered as aforesaid, shall give a receipt in writing for the same, and such delivery shall to all intents and purposes be a sufficient delivery under the provisions of this Act."

If a work be published anonymously the entry of the name, &c., of the first publisher will be sufficient. The provisions of the other Act before quoted, as to searches, entries, and copies in and from the register, apply to this Act, as they also do to the "Copyright in Paintings, Drawings, and Photographs Act."

"The Copyright in Paintings, Drawings, and Photographs Act" (25 & 26 Vict. c. 68) secures the rights of copyright to "every original painting, drawing, and photograph which shall be or shall have been made either in the British dominions or elsewhere," and provides that the author shall "have the sole and exclusive right of copying, engraving, reproducing, and multiplying such painting or drawing, or the design thereof, or such photograph and the negative thereof, by any means and of any size, for the term of the natural life of the said author, and for seven years after his death," subject to compliance with the Act in respect of registration at Stationers' Hall. The Act provides that there shall there be kept a book or books, entitled "The Register of Proprietors of Copyrights in Paintings, Drawings, and Photographs," wherein shall be entered a memorandum of every copyright to which any person shall be entitled under this Act, and also of every subsequent assignment of any such copyright; and such memorandum shall contain a statement of the date of such agreement or assignment, and of the names of the parties thereto, and of the name and place of abode of the person in whom such copyright shall be vested by virtue thereof, and of the name and place of abode of the author of the work in which there shall be such copyright, together with a short description of the nature and subject of such work; and, in addition thereto, if the person registering shall so desire, a sketch, outline, or photograph of the said work; and no proprietor of any such copyright shall be entitled to the benefit of this Act until such registration, and no action shall be maintainable, nor any penalty be recoverable, in respect of anything done before registration."

The effect of these statutes as to registration is to make it impossible for any person to maintain "any action or suit at law or in equity, or any summary proceeding in respect of any infringement of such copyright, unless he shall, before commencing such action, suit, or proceeding, have caused an entry to be made in the book of registry of the Stationers' Company." It will be observed that registration does not confer copyright, for that is personal property, but is merely a condition imposed for its security and regulation, compliance with which must be precedent to any attempt to enforce its rights and incidents.

STATIONS OF THE CROSS is a term referring to a devotional practice in favour with the Roman Catholic Church. It symbolizes the way to Calvary (*Via Calvaria*), with all its incidents and pauses, and these are usually made to amount to fourteen. At each station the worshipper pauses and kneels down just as he would if treading the actual sacred path in Palestine, meditates on the meaning of this particular station, and recites certain prayers. Often the pillars of a church serve as stations, each with its bas-relief or picture, and all leading up to the altar, which symbolizes Calvary. Elsewhere, as in Belgium and along the Rhine, a "Calvary" is erected in a realistic manner, and the path to it bears the stations in their proper order. A famous Calvary, with representations that are really works of art in themselves, exists near Bologna in Italy. Those in the Low Countries (as at Antwerp, for instance) are often over-coloured, and however valuable as aids to devotion, are not of much account æsthetically.

The term stations is also applied to the series of Basilicas of Rome appointed to be visited in turn by the devout as places of prayer on stated days.

STATIS'TICS is that department of political science which is concerned in collecting and arranging facts illustrative of the condition of a people and the resources of a state. To reason upon such facts and to draw conclusions from them is the business of the statesman and of the political economist.

In order to exemplify the precise character and limit of statistics, the Statistical Society of London have aptly chosen for their emblem a wheat-sheaf, with the motto "Aliis exterendum."

That it is necessary for a government, in order to govern well, to acquire information upon matters affecting the condition and interests of the people, is obvious. In this sense statistics may be said to be coeval with legislation; but it is chiefly to the rise of political economy, which since the middle of the last century has become an inductive science, that we are indebted for the cultivation of statistics. They have a twofold relation to political and social economy. The political economist bases his theories on the facts collected by the statist, and the application of those facts to social and economical problems is an appeal from imagination to fact. But the statist must be guided by the political economist in what direction to extend his investigations, so that without political economy we should have had no statistics.

It would be useless to attempt an enumeration of the various matters that are included in the province of statistics, but they may be generally divided into—(1) historical statistics, or facts illustrative of the former condition of a state; (2) statistics of population; (3) of revenue; (4) of trade, commerce, and navigation; (5) of the moral, social, and physical condition of the people.

Much stress should be laid upon the collection of facts by the highest authority of the state, because the classes of facts most important in political inquiries can scarcely ever be searched out by other persons, who are without authority to demand information, while the government has ample means at its disposal, and can without difficulty obtain statistical information of the highest value. In this and many other countries the respective governments are applying themselves earnestly to statistical investigations. In England there is a department at the Board of Trade to collect and arrange all the documents of a statistical nature that can be obtained through any department or agency of government, which publishes some exceedingly valuable monthly and annual reports, and also, since 1886, a monthly journal of special interest to persons engaged in trade and commerce. The admirably organized bureaux of the French government have abundance of statistical materials systematically collected, which they never fail to arrange in a very lucid manner, and to analyze with much ability. Germany, Austria, and Italy have also their statistical departments, but the Belgian statistical department is perhaps superior to any other in Europe.

STA'TIUS, PUBLIUS PAPINIUS, was one of the most distinguished poets of the silver age of Latinity. His writings gained him extensive popularity, and were warmly praised by his contemporary Juvenal. Notwithstanding his poetical fame Statius was very poor, and in his later years abandoned the empty applause of the capital for the comparative tranquillity of Naples. He was of an amiable character, and tenderly attached to his wife Claudia. He was born at Naples about A.D. 60, and died there about A.D. 100. Like Silius and Martial, he courted the favour of the tyrant Domitian by the most servile flattery. His extant works comprise the "Thebaid," an elaborate heroic poem in twelve books, on the mythical wars of Thebes;

the "Achilleid," a heroic poem on the exploits of Achilles, of which only the first two books survive—probably the work was left incomplete by the author; and the "Silvæ," a miscellaneous collection of short poetical pieces, consisting for the most part of epistles to his friends. The epic writings of Statius are graceful and pleasing, composed according to the strict rules of art, and evidently corrected and polished with the utmost care; yet in modern times they have been little read, for they evince a total want of the creative faculty, and show that Statius had quite mistaken his own powers. The best passages resemble a feeble imitation of Virgil. The "Silvæ," though evidently written with much less care, and consisting merely of occasional pieces, are far more interesting. Besides throwing much light on the manners and customs of the Romans in that age, many of them possess great literary merit. One of the most pleasing of these poems is that written in honour of the marriage of Violantilla. One of the best editions of Statius is that by Lemaire in the Bibliotheca Classica (Paris, 1830).

STA'TOR, "The Stayer," a surname of Jupiter at Rome, to whom a special temple of peculiar sanctity was built under this name, because of his assistance in battle in times of danger, steadying the ranks when duly invoked, and also as typifying the Roman desire for order and stability in affairs generally.

STAT'UARY. See SCULPTURE.

STAT'UTE. Bills which have passed through the Houses of Lords and Commons and received the royal assent become Acts of Parliament, and are sometimes spoken of collectively as forming the body of Statutes of the Realm. But a more restricted application of the word is generally in use, by which private Acts of Parliament are excluded, and even public Acts when their purpose is temporary. The application is still more restricted when the measures of the early Parliaments are the subject in question, for many Acts passed and received the royal assent which belong to the class of public Acts and are found at large on the Rolls of Parliament, yet are not accounted statutes in the sense in which that word is ordinarily used.

No strict definition can be given of those results of the deliberations in Parliament to which the sovereign has signified assent, which are now called the Statutes of the Realm. We may distinguish them from other enactments of early times as follows:—They were at a very remote period separated from the rest, written in books apart from the rest, and received by the courts of law as of equal authority with the ancient customs of the realm.

Three volumes, now in the custody of the Master of th Rolls, contain the body of those enactments which are called statutes. One of them contains the statutes passed be fore the beginning of the reign of Edward III., and the other two those from 1 Edward III. to 7 Henry VIII., all very fairly written. These may be considered as the manuscripts of the early statutes of superior value, if not of superior antiquity as to the earlier portions, to the many similar collections which are in the libraries of the Inns of Court, of the universities, of the British Museum, and some other depositories, public and private. These numerous manuscript copies of the statutes are in substance pretty nearly the same, though some of these collections contain statutes which are not admitted into others. These books are not considered in the light of authorized enrolments of the statutes. For the authentic and authoritative copies, if any question arises, recourse must be had (1) to what are called the Statute Rolls at the Tower, which are six rolls containing the statutes from 6 Edward I. to 8 Edward IV., except from 8 to 25 Henry VI.; (2) to the enrolments of Acts of Parliament which are preserved at the Rolls Chapel from 1 Richard III.; (3) to exemplifications and transcripts with writs annexed, signifying that they were transmitted by authority to certain courts or other parties, who were required to take notice of them, of which many remain in the Exchequer and elsewhere; (4) those since 12 Henry VII. to the original Acts in the Parliament office; (5) the rolls and journals of Parliament; (6) the close, patent, fine, and charter rolls at the Tower, on which statutes are sometimes found.

With the Parliament of the reign of Richard III. began the practice of printing, and in that manner publishing, the Acts passed in each session. This followed very soon after the introduction of printing into England. Before that time it had been a frequent practice to transmit copies of the Acts, as passed, to the sheriffs of the different shrievalties to be promulgated by them. The practice of printing the sessional statutes has continued to the present time.

Before the first of Richard III. the aid of the press had been called in to give extended circulation to the older statutes. Before 1481 it is believed that an abridgment of the statutes was printed by Letton and Machlinia, which contains none later than 33 Henry VI., 1455. To the next year is assigned a collection, not abridged, from 1 Edward III. to 22 Edward IV. Next to these in point of antiquity is a collection printed by Pynson about 1497, who also, in 1508, printed what he entitled "Antiqua Statuta," containing Magna Carta, Carta de Foresta, the Statutes of Merton, Marlbridge, and Westminster primum and secundum. This was the first publication of those very early statutes.

In the reign of Henry VIII. the first English abridgment of the statutes was printed by Rastall; and during that reign and in the succeeding half-century there were numerous impressions published of the old and recent statutes in the original Latin and French, or in English translations. Barker, about 1587, first used the title "Statutes at Large." In 1618 two large collections of statutes, ending in 7 James I., were published, called Rastall's and Pulton's. Pulton's collection was several times reprinted with additions.

In the eighteenth century an edition, in six folio volumes, was published by Mr Serjeant Hawkins in 1735, containing the statutes to 7 George II. Cay's edition, in 1758, in the same number of volumes, contains the statutes to 30 George II. Continuations of these works were published as fresh statutes were passed; and another work of 4to, of the same kind, was begun in 1762, known by the designation of Ruffhead's "Statutes at Large." Pickering's edition is in 8vo, and ends with 1 George III. A commission is now in existence for the revision and consolidation of the whole of the statutes of the United Kingdom.

None of these collections were published by authority of the state. A committee of the House of Commons, which, in 1800, was appointed to inquire into the state of the Public Records, recommended, among other things, that "a complete and authoritative edition of all the statutes should be published." A commission was appointed for carrying into effect the recommendations of this committee, and between 1810 and 1824 was produced, in a series of large volumes, a critical edition of the statutes (including the early public charters), ending with the close of the reign of Queen Anne. This is what is now considered the most authentic edition of the statutes, and it is supplied with a valuable index. It forms ten folio volumes.

The statutes passed in the Imperial Parliament of Great Britain are printed in foolscap folio, and sold in separate Acts, at the rate of three halfpence a sheet (four pages) for public Acts, and threepence a sheet for private acts. An 8vo edition is also published, which is sold at the rate of one penny a sheet (sixteen pages 8vo).

The statutes of the realm are generally divided into two classes—Public and Private; but they may more con-

veniently be distributed into three classes—Public General, Public Local, and Private. The two former only come within the term "laws," in the proper acceptation of the term. Private Acts empower individuals to do certain acts which otherwise they could not do; and they are not noticed in courts of law, unless they are pleaded. The public local statutes, though published separately, and though the standing orders of the Houses of Parliament require that on account of the private interests which they are often likely to affect, certain preliminary notices and other proceedings should take place before they are passed through their stages, are yet in the same position as the public general statutes. Formerly all the public statutes, local and general, were published together and numbered consecutively; but since 1798 the local Acts have been separately enumerated in distinct volumes. By the 13 Vict. c. 21, s. 6, it was enacted that every Act passed was to be deemed and taken to be a public Act, unless expressly declared to the contrary.

Statutes of Ireland.—In Ireland the method by which the early irregular convocations, called Parliaments, passed their Acts, appears to have been a close imitation of the English practice. The authenticated printed statutes begin in the year 1310, 3 Edward II. After five short Acts of this Parliament there is a blank until the year 1429, although several parliaments were held in the interval. Many of these statutes are characteristic indications of the state of the country, and throw light on the domination of the English over the natives. The Statute of Drogheda, commonly called Poyning's Law, passed in 1495 (10 Hen. VII.), had a marked influence on the later legislation and constitutional history of Ireland. By chap. 22 it was enacted that all the Acts then or lately passed in England, "concerning or belonging to the common and public weal of the same," should be law in Ireland. By chap. 4 it was provided that no Parliament should afterwards be held in Ireland until the lord-lieutenant and council had certified the king of the causes and considerations for holding it, and of the Acts proposed to be passed at it, and a license had been obtained from England accordingly. Thus no measure could be proposed for the adoption of Parliament until it had first received the royal assent in England. This Act was repealed, and the independence of the Irish legislature restored by the measure of 1783. By the Act of Union, in 1800, the Irish Parliament was merged in the United Parliament of Great Britain and Ireland. See PARLIAMENT, IMPERIAL.

STATUTE OF FRAUD. See FRAUD.

STATUTES OF LIMITATION. See LIMITATION, STATUTES OF.

STAU'ROLITE (Gr. *stauros*, star, *lithos*, stone), a yellowish to reddish-brown or brownish-black mineral, often found crystallized in the form of crosses (twin crystals), in mica schist and gneiss. It consists chiefly of the silicate of alumina and iron, with a little magnesia, and the crystals belong to the rhombic system.

STAVE, sometimes also called *Staff*, the series of horizontal lines, now always five in number, on which the notes of music are written. See NOTATION OF MUSIC.

STEAM is the dry invisible vapour of water. This is the scientific definition of steam. In a popular sense steam comprehends also the wet visible cloud or mist which is produced when dry invisible steam is mixed with air colder than itself, so as to be partially condensed into very small particles of water.

Steam is a compound of one part by weight of hydrogen with eight parts by weight of oxygen, making nine parts by weight of steam. Its composition by volume is one volume of hydrogen to half a volume of oxygen, making one volume of steam in the perfectly gaseous state. Hence, when steam is in the perfectly gaseous state, its density, at a given pressure and temperature, is to that of hydrogen as 9 to 1; to that of oxygen, as 9 to 16; and to that of air, as 5 to 8.

If the absolute pressure of steam in the perfectly dry gaseous state is expressed in pounds on the square foot, and the volume occupied by one pound of it in cubic feet, the product of those two quantities, at the temperature of melting ice, is 42,141 foot-pounds, and at other temperatures it varies as the absolute temperature measured from the absolute zero, which is 274° C. or 493° Fahr. below the temperature of melting ice.

Ordinary visible, steam especially if in contact with liquid water, has almost always a greater density than that corresponding to the perfectly gaseous state.

The latent heat of steam is the heat which disappears in converting one pound of water from the liquid to the vaporous state. At the atmospheric boiling point (100° C. or 212° Fahr.) the latent heat of one pound of steam is nearly 537 thermal units C., or 966 thermal units Fahr.; that is, nearly equal to the heat which would raise the temperature of 537 lbs. of water 1° C., or 966 lbs. of water 1° Fahr.; and its value diminishes by 0·7 of a thermal unit nearly for every increase of one degree in the boiling point.

In common with all other substances water has the property that to each temperature there corresponds a pressure called the *pressure of saturation*, which is the least pressure consistent with the liquid state and the greatest pressure consistent with the gaseous state at the given temperature, and therefore the only pressure at which the vapour of the substance can permanently exist in a closed vessel at the given temperature in contact with the same substance in the liquid or solid state. The given temperature is the boiling point corresponding to the pressure of saturation. The atmospheric boiling point is that corresponding to a pressure of saturation equal to the mean atmospheric pressure of 14·7 lbs. on the square inch; for water it is 100° C. or 212° Fahr. The relation between the boiling point and the pressure of saturation is given very accurately by the approximate formula—

$$\log p = A - \frac{B}{t} - \frac{C}{t^2};$$

in which p is the pressure; t the absolute temperature of the boiling point, found by adding 274° to the temperature on the centigrade scale, or 461° to the temperature on Fahrenheit's scale; and A, B, C, three constants depending on the nature of the substance, whose values for steam, when pressures are expressed in pounds on the square inch and temperatures in Fahrenheit's degrees, are as follows:— $A = 6·1007$, $B = 2732$, $C = 896945$.

A pound of good coal, used under a good steam boiler, will evaporate 10 lbs. of water at a temperature of 320° Fahr., and a pressure of 75 lbs. per square inch above the atmosphere, the temperature of the water when entering the boiler being 40°. The specific heat of steam under constant pressure is 0·480. At constant volume it is 0·365; *i.e.*, the quantity of heat per pound required to raise the temperature of steam, where its expansion is just sufficient to keep its pressure constant, is 0·480 thermal units; and, when confined within an unchanging space, its pressure rising with its increase of temperature, the heat required per degree is 0·365 unit. The thermal unit is the quantity of heat required to raise the temperature of one pound of water one degree at the temperature of maximum density. The value at other temperatures is practically the same. Steam, when perfectly free from particles of water, is dry, invisible, and in its physical properties similar to other gases. Its density (air=1) is 0·622. In changing in temperature one degree under constant pressure, it absorbs heat equal to 85·77 foot-pounds of work. The work of the evaporation of a cubic inch of

water at 212° is nearly equal to that of raising a ton one foot. A cubic inch of water makes about a cubic foot of dry steam. Its coefficient of expansion becomes equal to that of perfect gases at about 18° above the temperature due to its pressure, according to Fairbairn and Tate. Steam expanding while doing work, as in the steam cylinder of an engine, becomes partially condensed. When expanding without doing work it superheats, the difference of total heats at the temperatures of the extremes of pressure becoming observable as sensible heat in the production of this superheating. The elastic force of saturated steam being dependent only upon its temperature, the relation may be expressed by a mathematical formula. Many such formulas have been proposed, none of which are exact. The simplest is Tredgold's, $t=175\sqrt[6]{A}-75$, in which t i the temperature, F and A the number of atmospheres of pressure. This is correct, within two degrees, from one up to above 25 atmospheres of pressure, and is much more nearly accurate at the extremes of that range. In Southern's formula, which has been much used by engineers,

$$P=\left(\frac{t+51{\cdot}3}{135{\cdot}767}\right)^{5{\cdot}15}+0{\cdot}1,$$

in which P is the pressure in inches of mercury. These formulas are now seldom employed, as every work upon this subject contains a table of pressures, temperatures, and volumes. The relative volumes of steam and water can be calculated by the formulas of Fairbairn and Tate:

$$V=25{\cdot}62+\frac{49513}{P+0{\cdot}72}.\quad P=\frac{49513}{V-25{\cdot}62}-0{\cdot}72.$$

The relative volume or density of steam under varying pressure can be computed by the use of Rankine's formula, $\frac{V}{V'}\left(\frac{P'}{P}\right)^{\frac{16}{17}}$, in which V and P are the volume in cubic feet, and the pressure reckoned above a vacuum, in pounds per square inch, of one pound of steam at the given pressure, and V′ is the volume (26·36 cubic feet) of one pound of steam at P′, the atmospheric pressure. Steam expanding in the cylinder of a steam-engine does not follow the law of expansion of permanent gases, nor does the variation of the ratio of pressure to volume follow any law which has yet been exactly expressed mathematically. Rankine considers that pressure varies inversely as the $\frac{10}{9}$ power of the volume, where the steam neither gains nor loses heat, and as the reciprocal of the $\frac{17}{16}$ power where kept dry by a steam jacket. More exactly, $P \alpha V^{-1{\cdot}0646}$, and $\log V=2{\cdot}516-0{\cdot}939 \log P$.

Steam formed from sea-water is liberated at a higher temperature than when formed from pure water. The boiling point of water is raised about 0·04° Fahr. for each increment of 1 per cent. of its own weight of salt. Sea-water, containing $\frac{1}{32}$ of its weight of salt, boils at 213·2° Fahr. under atmospheric pressure. The maximum proportion of salt permitted in marine steam boilers is usually $\frac{3}{32}$, the boiling point being raised 2·4° Fahr. Steam, as worked in the steam-engine, if not dried by superheaters, is wet, *i.e.* it carries in suspension fine particles of water. The principal advantage of superheating is an increase of economy due to the thorough expulsion of water from the vapour, and consequent reduction of loss by condensation and revaporization in the steam engine cylinder. The most elaborate and most accurate experimental determination of the coincident temperatures, pressures, and volumes of saturated steam were made by Regnault, at the expense of the French government, and under the auspices of the Academy of Sciences, and published in the *Mémoires de l'Académie* for 1847. The following table gives a summary of the properties of steam based upon Regnault's determinations. Pressures are given in pounds per square inch above a vacuum, and in inches of mercury measuring from the same point. Volumes are relative to water at its greatest density. Weights are given in pounds, and specific gravity is referred to air as unity at a temperature of 32° Fahr. The distribution of heat in each pound of steam evaporated at 212° Fahr. is given as follows:—

	British Units of Heat.	Foot-Pounds.
A. The sensible heat:		
1. To heat the water from 32°, or through 180°, ...	180·9°	=·13965
B. The latent heat:		
2. To convert the water to vapour, irrespective of pressure on surface, ...	892·9°	=689242
3. To advance against and remove the incumbent atmosphere, whether air or previously generated steam, its pressure being 2116·8 lbs. per square foot of surface, ...	72·3°	= 55815
Total latent heat, ...	965·2°	=745057
Total heat of steam, . .	1146·1°	=884712

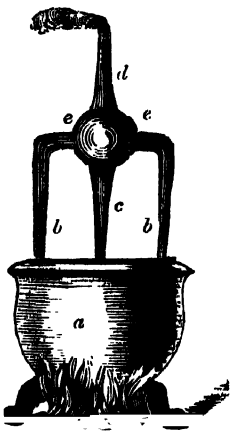
It is evident that the total latent heat of steam cannot be taken as in any way the measure of the energy or work or that can practically be obtained from, the steam. Much the larger part of such heat is expended in merely overcoming the cohesion of the liquid; and at all temperatures but a small fraction of the latent heat can be made available in performing work. Of the total, seven-tenths are lost through the existence of natural conditions over which man can probably never expect to obtain control, two-tenths through imperfection of mechanism, and but one-tenth is utilized in even good engines.

STEAM-ENGINE. A steam-engine is a machine by which heat-energy, obtained by the combustion of some fuel, is converted into mechanical work, aqueous vapour being employed for effecting the transformation. The heat of combustion is as far as possible imparted to water in a closed vessel termed a *boiler*, the water being converted into steam, which, occupying an enormously greater volume, is allowed to pass under pressure from the boiler and to act alternately on the two sides of a movable piston working backwards and forwards in a cylinder. When the piston has been driven by the pressure of the steam to either end of the cylinder, the communication between that side of the piston and the boiler is cut off and another communication opened to allow the steam to escape. As the steam rushes out of the cylinder the pressure against the piston falls, and steam being admitted from the boiler to the opposite side the piston is driven in an opposite direction. If the purpose of the engine is merely to work pumps or machinery requiring only a reciprocating motion, a rod attached to the piston can be connected directly to the pump to be worked. When the engine has to drive some machinery having a rotary motion a simple mechanical arrangement is employed to convert the reciprocating motion of the piston into the rotation of a crank. The principles of the mechanical theory of heat have only been thoroughly investigated within the last thirty years, and the results, as applied to the improvement of the steam-engine, have been the means of obtaining from that machine a larger amount of useful work with a given expenditure of fuel.

History.—The earliest written account of mechanism in which heat is made to perform work by means of steam is contained in the "Pneumatics" of Heron of Alexandria, who flourished about 130 B.C. That author refers to a rotary engine, or steam turbine, driven by the reaction

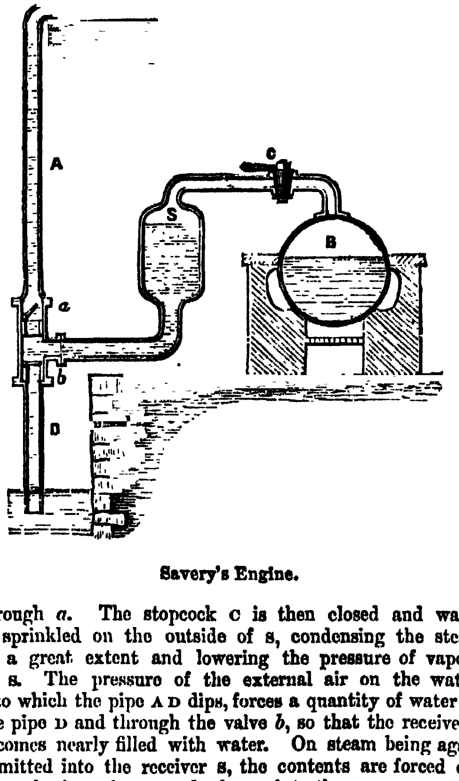
of jets of steam issuing from orifices in revolving arms, and also some pieces of apparatus in which the pressure of steam, or of heated air and vapour mixed, is made to raise liquid by expelling it from a receiver. There can be little doubt that the properties of steam and air on which those contrivances depended were known for ages before Heron's time; and it is believed that the Egyptian priests made use of them in the performance of pretended miracles. An apparatus similar to that last mentioned is noticed by Giovanni Battista della Porta in his "Pneumatics," published in 1601, with this addition, that the condensation of steam within a closed vessel is described as a means of producing a vacuum, and thereby causing water to ascend and fill the vessel. One form of the reaction-wheel is represented in fig. 1. In principle it is founded upon that law of motion which maintains that all action has an equal and contrary reaction as far as momentum is concerned; for instance, on the discharge of a musket, the equivalent to the forward momentum of the ball and ignited gas is the recoil of the gun barrel, but as the mass of the latter is much greater, the velocity is, of course, much smaller. The vase *a* contains water, which is made to boil by the fire underneath, and the steam ascending by the two hollow arms *b b*, enters the reservoir *e e*, which is arranged to rotate freely upon the bent ends of the arms *b b* by a steam-tight joint. The accumulated steam in the reservoir *e e* is forcibly discharged through the nozzles *c d;* these nozzles may therefore be compared to musket barrels, at each nozzle there being a recoil, the exact equivalent of the momentum of the issuing steam. As the issue of steam is continuous, the recoil is continuous, and the nozzles being so arranged that these forces of recoil form a couple, a rapid motion of rotation of the reservoir about its axis is obtained. A French engineer, Solomon de Caus, in a work entitled "Les Raisons des Forces Mouvantes," published in 1615, explained a machine for propelling a jet of water to a great height by the pressure of steam produced in the same vessel from which the water was ejected. In 1629 Branca invented an engine in which a wheel was driven round by the impulse of steam against vanes. Edward Somerset, second marquis of Worcester, in his work called "A Century of the Names and Scantlings of Inventions," &c., published in 1663, described a machine for raising water by the pressure of steam. So far as the description is intelligible it appears that this machine differed from that of De Caus in having a separate boiler for the production of the steam which forced water out of other vessels; and it appears further, from the diary of Cosmo, grand-duke of Tuscany, that the machine of the Marquis of Worcester had been constructed and was in operation at Vauxhall in 1656, being thus the *first practical steam-engine*. It is probable that, in the time of the Marquis of Worcester, the action of steam in exerting a great pressure when confined within a limited space, and the possibility of raising water to a height by means of it, had become generally known to persons acquainted with mechanics, and that the original part of his machine was the *separate boiler*, without which it would have been practically useless. About 1697 Captain Savery invented an engine in which water was not only (as in that of Worcester) forced above the level of the engine by the pressure of the steam from a separate boiler, but was also raised to the level of the engine from a lower level by the pressure of the atmosphere, after the condensation of the steam in the water receiver by means of cold water externally applied. This engine was extensively used for draining mines. The previous discovery of the law of atmospheric pressure being known, Savery's engine (fig. 2) was based on the principle of the barometer, water being forced upwards into an empty receiver by atmospheric pressure, and afterwards carried to an additional height by the pressure of steam. The principle of the engine will be understood by reference to the following diagram. Steam is generated in a boiler, B, and passes into a receiver, S, which communicates with a pipe, A D, leading from some water below the level of the machine to a reservoir overhead. At *a* and *b* are two clack valves, each opening upwards. The action is as follows: —The stopcock C being opened, the rush of steam from the boiler expels the air from S, by driving it upwards through *a*. The stopcock C is then closed and water is sprinkled on the outside of S, condensing the steam to a great extent and lowering the pressure of vapour in S. The pressure of the external air on the water, into which the pipe A D dips, forces a quantity of water up the pipe D and through the valve *b*, so that the receiver S becomes nearly filled with water. On steam being again admitted into the receiver S, the contents are forced out through the valve *a* and pipe A into the upper reservoir.

Fig. 1.



Heron's Engine.

Fig. 2.

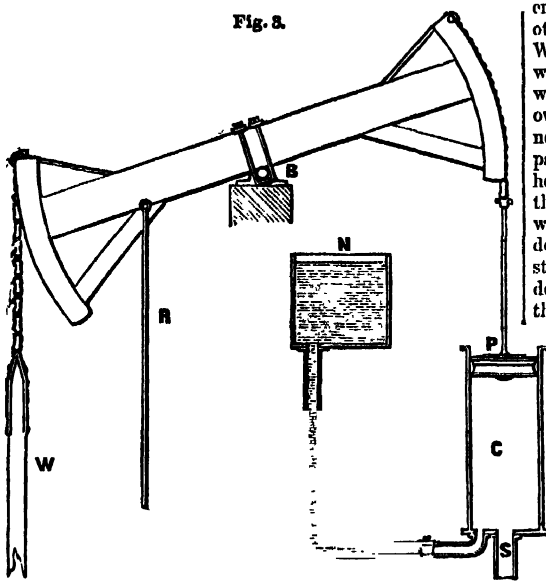


Savery's Engine.

In all the machines hitherto described the steam either acted by its momentum alone, or by pressing directly on the surface of water. The first conception of the important idea of making steam drive a *piston*, which should communicate the motion to mechanism, appears to be due to Denis Papin, who, about the year 1690, constructed a working model, consisting of a vertical cylinder with a piston. In the lower part of the cylinder was placed a small quantity of water. On placing a fire under the cylinder the water evaporated and lifted the piston; on removing the fire from the cylinder, or the cylinder from the fire, the steam was condensed, and the piston forced down by the pressure of the atmosphere.

Papin proposed that engines on this principle should be made to work pumps, and also, by means of rack and pinion work and ratchet wheels, to drive paddle wheels of vessels and other revolving mechanism; but he did not carry these proposals into effect. Papin had, about ten years before, invented the safety valve for boilers. In 1705 Newcomen, Savery, and Cawley combined the cylinder and piston with the separate boiler and with surface condensation, and produced the well-known atmospheric engine for pumping mines. They afterwards rendered the condensation more rapid and complete by injecting a shower of cold water into the interior of the cylinder.

Fig. 3.



Newcomen's Engine.

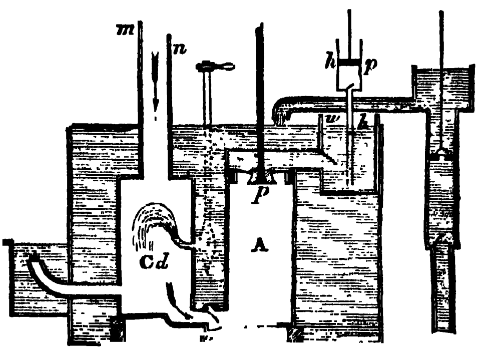
The general arrangement of Newcomen's engine will be understood by reference to the above diagram (fig. 3). A piston, P, movable in the steam cylinder, C, was attached by a chain to one segmental end of a working beam, B, the pump-rod, W, being hung by a chain at the other end. The boiler was placed directly under the cylinder, to which steam was admitted by a regulator valve and the pipe S. A pipe leading to a cistern of water overhead, N, admitted water by means of an injection cock. The rod, R, was employed for working the valves. The weight of the pump was always greater than that of the piston, and therefore acted as a counterpoise to keep it up at the top of the cylinder unless forced down by external pressure. To work the engine it was necessary that the pressure of steam in the boiler should be at least 1 lb. per square inch in excess of that of the atmosphere. On the condensation of the steam the pressure was removed from the lower surface of the piston, which descending by virtue of atmospheric pressure, lifted the pump-rod together with the column of water resting on the bucket.

The Newcomen engine was greatly improved in its construction by Smeaton, who erected an engine for the Chasewater mine in Cornwall, which had a cylinder 6 feet in diameter with a 9-feet stroke, and worked up to 76 horse-power. The great beam was 27 feet in length. The weight of the column of water in the pumps was about 14 tons, and there were three boilers, each 15 feet in diameter. The several improvements in Newcomen's atmospheric engine prepared the way for the genius of Watt to produce what may be termed a steam-engine.

James Watt, philosophical instrument maker to the University of Glasgow in the year 1763, was employed to repair a model of a Newcomen engine. Observing various faults in its construction, after a series of laborious experiments he carried out certain improvements which have inseparably connected his name with the steam-engine. Watt clearly saw that the cylinder of the engine should always be kept hot, and that therefore there was great waste of energy in the same cylinder being heated and cooled alternately, first by the entrance of the steam, and afterwards by the injection of cold water to produce condensation. His first important improvement was therefore to effect condensation in a separate chamber, so that the engine cylinder was always kept as hot as possible. Another improvement was the introduction of the air-pump. Watt saw that the steam in condensing heated the cold water, adding to its bulk, and at the same time the air which is always contained in water became disengaged, owing to the heat and the reduced pressure. The usefulness of this separate chamber would thus be greatly impaired unless arrangements existed for pumping out the heated water and the air. This air-pump was driven by the engine itself, and further to economize heat the boiler was fed by means of the heated water. The condenser, as designed by Watt, is shown in fig. 4, in which *m n* is the steam inlet; *c d* the condenser, where the steam is condensed by a jet of cold water; A P, the air-pump, by which the condenser is emptied of hot water, &c.; *h w* the hot well, and *h p* the feed-pump, by which this water is returned to the boiler. Watt further transformed the atmospheric engine into a double-acting steam-engine. In Newcomen's engine it is necessary for the cold atmosphere to have access to the interior of the cylinder, but Watt devised the plan of employing the pressure of steam in place of that of air, the steam being admitted alternately on either side of the piston, the exhausted steam being condensed, and in order to keep the cylinder as hot as possible and prevent radiation into the surrounding air, he introduced a non-conducting jacket. In the best engines this takes the form of a steam jacket.

Watt also introduced the important improvement of expansive working, in order to avoid the momentum of the ascent of the piston in the cylinder increasing throughout the stroke and sudden cessation at the end, and to extract from the steam more of the energy due to its elastic force.

Fig. 4.



This was effected by shutting off the communication with the boiler before the piston had completed its stroke, the remainder of the stroke being performed by the continually diminishing pressure of the expanding steam.

The condensing steam-engine, as it now exists, consists of three essential parts:—1st, the *boiler*, in which the steam is generated and raised to working pressure; 2nd,

the *cylinder* or cylinders, in which it does its work; and 3rd, the *condenser*, in which it is reduced again to the form of water, thus completing the cycle of changes. We shall describe these parts separately.

Boilers.—The construction of a boiler has to be regarded from two points—the general form and structure best adapted to withstand the bursting pressure of the steam; and the considerations arising from the unequal action of the heat of burning gases, and the precautions to be observed for economizing the consumption of fuel.

The early boilers were constructed without reference to form, reliance being placed upon the strength of the metal to prevent explosion, and not on its form. There is no doubt that the safety of all boilers depends upon the strength of the metal, but the form of the shell is of the greatest importance. The strongest form of vessel for containing a gas under pressure is a sphere, but in practice such a form is inadmissible. The next best form theoretically is a cylinder, which may be of any size, its weakest points being the two ends. When steam was first employed at about atmospheric pressure, the shape of the boiler somewhat resembled that of a tea-kettle. This was shortly superseded by Watt's waggon-boilers, designed for a greater economization of the heat. In this form of boiler the fire is placed underneath the shell, and there is an arched base to prevent an accumulation of deposit, together with curved sides, so as to present a larger amount of surface in the flues. The arrangement of the flues is such that the heated gases, after passing under the boiler, traverse successively the flues on each side of the boiler before passing into the chimney. The Lancashire boiler is generally understood to have been introduced in 1844 by Fairbairn and Hetherington, and is cylindrical in form, with flat ends, having two internal fire-tubes—each furnace being inclosed within its respective tube—instead of one, as is the case with the Cornish boiler, introduced by Trevethick during the early part of the present century, and which virtually forms the type from which the Lancashire boiler has been derived. The two fire-tubes in the Lancashire boiler of necessity regulate the diameter of the shell. They are generally 2 feet 9 inches in diameter, and the shell of the boiler 7 feet. If the fire-tubes are 3 feet diameter, the shell will be 7 feet 6 inches diameter. Short boilers evaporate more rapidly in proportion than long boilers. The usual length is 27 feet, the maximum length 30 feet. In the Lancashire boiler, the hot gases, after passing along the furnace-tubes, dip under the boiler, and after circulating along flues on each side of the shell having a breadth equal to the radius of the shell, the gases meet again at the end of the boiler, and find their way into the chimney stalk. In the modern construction of boilers it is usual to introduce an economizer or apparatus in the main flue for heating the feed-water, consisting of a group of water pipes which absorb heat fron the waste gases and return it to the boiler at a temperature of about 115° C.

The strength of the internal tubes of the Lancashire boiler has been investigated by Sir W. Fairbairn, with the following results:—

The strength of a tube to resist collapse by external pressure is inversely as its diameter.

The strength varies inversely as the length.

The collapsing pressure in pounds per square inch

$$=806300 \times \frac{(\text{thickness in inches})\ 2\cdot19}{\text{length in feet} \times \text{diameter in inches.}}$$

These experiments have been very valuable as directing attention to the importance of introducing special contrivances for strengthening furnace flues, while allowing at the same time for their expansion and contraction.

Those fittings for a boiler which require most frequent handling are usually placed in front and within easy reach of the attendant. The *feed-water pipe* is a vertical pipe which enters the boiler on one side above the level of the furnace tubes, and is carried inside for a distance of 10 feet or more in a horizontal direction, the last 4 feet of its length being perforated. The reason for carrying the feed-water some distance along the interior of the boiler before it is dispersed is to moderate as far as possible any inequality of temperature. On the opposite side of the boiler a vertical pipe is generally attached for the purpose of removing any scum which may have collected in a sediment-catching trough inside the boiler with which it communicates. At the bottom of the boiler a *blow-out cock* is fixed for clearing out the water when required.

The *furnace doors* of the fire-tubes are provided with some arrangement for admitting and regulating the supply of air. The standard length for the fire-grate is 6 feet, the fire-bars ⅞-inch thick and ⅜ inch apart.

The pressure gauge most commonly in use is that invented by M. Bourdon, a French engineer. It is based upon the fact that a coiled flattened tube when subjected to interior pressure tends to uncoil itself, and the amount of uncoiling and pressure is recorded by an index-finger moving over a graduated arc, the divisions of which represent pounds pressure of steam in the boiler.

The water gauge, of which there are two, so as to check one another, consists of a glass tube mounted in metal bearings, the joints packed so as to be steam and water tight. Each gauge is furnished with three stopcocks, which can be opened or closed at pleasure, so that any of the passages can be blown through by steam or water from the boiler.

Connecting pipes, such as the main steam-pipe or feed-pipe, should be fixed so as to allow for some compensating movement incident to the expansion or contraction under the extremes of temperature to which they are exposed. This is usually effected by the introduction of a copper elbow-pipe or a wrought-iron horseshoe-shaped pipe, which, yielding by bending, relieves the thrust or pull caused by expansion or contraction. Some boilers are constructed with a *steam dome*, from which the supply of steam is drawn; in others it is omitted, and an internal perforated pipe, or *anti-priming* pipe, takes its place.

Safety-valves.—The common form of safety-valve, held down by a lever and weight, was the invention of Papin before the date of Newcomen's engine, and resolves itself into the problem that occurs in the case of the ordinary steelyard.

The construction of a safety-valve may be varied from this original type in two distinct ways. Instead of employing a weight a spring balance may be employed, and this form is of common occurrence on locomotive boilers. Again, the lever may altogether be dispensed with, and the valve loaded by a weight placed immediately over it, or it may be held down by a spring. This form of safety-valve is largely used in stationary engines. By an ingenious arrangement in the construction of a safety-valve it has been contrived that the valve shall blow off, not only when the pressure of the steam rises beyond a certain point, but also when the level of the water in the boiler sinks below a given level.

Combustion of Fuel.—Heat being the agent which performs work in an engine, and the steam or vapour simply the instrument for transmitting the motion of heat to the machinery, it is essential to store up in this elastic working substance as much of the heat derived from the combustion of the fuel as possible. It is well ascertained that *chemical combination* is, as a rule, accompanied by the production of heat, and *chemical decomposition* by the disappearance of heat equal in amount to that evolved during the previous combination of the elements which are undergoing separation. *Combustion* is the name given to rapid chemical

combination attended with the production of intense heat; and the *calorific power* of a substance is the number of units of heat produced by the combustion of a unit of weight of the substance. If this unit of heat is measured by the centigrade scale,

The calorific power of hydrogen is 34·462.
" " of carbon is 2·473 when burnt to CO.
" " " 8·080 " CO_2.

Again,

1 lb. of hydrogen evaporates 64·2 lbs. of water at 100° C.
" carbon burnt to CO, 4·6 " "
" " " to CO_2, 15·0 " "

While the absolute heat of combustion cannot be increased, the waves of heat may be gathered up in an inclosed space, so as largely to increase the heating power.

Every boiler furnace must be considered as a vast chemical apparatus, in which coal and air are mixed together in the best proportion for burning the fuel without waste. In the laboratory 1 lb. of coal will cause sufficient heat to evaporate, say, 14 lbs. of water; but in practice, where it is impossible on a large scale to carefully protect the boiler, the evaporation per pound of coal seldom exceeds 10 lbs. or 10½ lbs. of water—more commonly the evaporation reaching only from 6 lbs. to 8 lbs. of water. As the question of proper combustion is one of the admixture of fuel and air in the furnace, the proportions adopted are usually those quoted by Professor Rankine, who states that for the efficient combustion of ordinary coal in a furnace 12 lbs. of air are required to combine with the constituents of each pound of coal.

But as it is necessary to largely dilute the gaseous products of combustion to enable the air to get to the fuel, as much air again is required, making a supply of 24 lbs. air to each pound of fuel. It may be stated here that 13 cubic feet of air, at 15·5° C., and under a pressure of 30 inches of mercury, will weigh about 1 lb. Consequently, 312 cubic feet of air are needed for each pound of fuel, which is equivalent to nearly 700,000 cubic feet of air for the effective combustion of 1 ton of coal.

The various ways in which fuel is wasted are thus classified by Rankine:—Fuel is lost by the escape of gases in an unconsumed condition, as well as by permitting in the firing black smoke to be thrown off. These defects of combustion may be traced to a defective supply of air, and arise from the remarkable affinity of hydrogen for oxygen gas, in consequence of which the oxygen is absorbed, to the exclusion of the carbon in the first instance. Again, there is waste of heat from external radiation and conduction. M. Peclet states that the quantity of heat radiated from incandescent charcoal is ·5 of the total heat of combustion, and that the heat radiated from coal slightly exceeds that radiated from charcoal. The practical data to be gathered from this statement is, that it is necessary to carefully intercept the heat radiating in every direction from burning fuel.

As regards the loss of heat by conduction, that is obviated as much as possible by the use of firebrick, and where the furnace is outside the boiler the resistance to conduction is increased by employing double layers of brickwork, with inclosed air-spaces between the layers. Again, there is loss of heat by the escape of gases up the chimney at a temperature above that which is requisite for maintaining the draught. By the old rule the area of the chimney was made $\frac{1}{10}$ that of the fire-grate, and there was allowed one square foot of fire-grate for each horse-power.

Rankine gives formulæ for calculating the height of a chimney in order to produce a given draught, and he states that the best chimney draught takes place when the absolute temperature of the gas in the chimney is to that of the external air as 25 is to 12, or when the density of the hot gas is one-half that of the external air.

Marine Boiler.—The marine boiler of the old-fashioned type was only provided with flues, and was, in 1817, never worked beyond a pressure of 3 to 5 lbs. above the atmosphere. When screw ships were adopted in the navy one of the first of the new series of vessels, the *Arrogant*, was designed to raise steam at 6 lbs. pressure; but as the ship was deep in the water the boiler would not blow off under 7 lbs. Mr. Penn, the engineer, however, soon raised the pressure to some 16 or 17 lbs. Within the last fifteen years a great change has occurred in marine engines and boilers, and the pressure of steam is now often 150 lbs. The old flue arrangement has given place to tubes, the furnace is inclosed entirely within the shell, and the hot gases pass through the series of horizontal tubes, which are larger in diameter than those in a locomotive boiler, being from 3 to 4 inches in diameter. After passing through the tubes the gases enter a smoke-box and rise by the uptake into the funnel. Such boilers are called multitubular boilers. The shell of a marine boiler may consist of a cylinder 12 feet in diameter and about 10 feet long, the ends being flat, the series of tubes running horizontally through the water space above the fire. Before entering upon the working details of the steam-engine, it is desirable to examine generally the properties of the vapour of water.

Mechanical Relations of Heat to Steam.—Heat is a quality or condition possessed by all bodies in nature, which are said to be *hotter* or *colder* according as they possess it in greater or less intensity. There is a constant tendency to transfer this condition from hotter to colder bodies, until a state of balance or equilibrium of heat is established between them, when that tendency ceases.

Two or more bodies which are in equilibrium as to heat, or have their heat *equally intense*, are said to be at the *same temperature*. The temperature or intensity of heat in bodies is measured by means of *thermometers*.

Quantity of Heat.—The thermometer, when used alone, measures only the *intensity* of heat, upon which depends its tendency to pass from one body to another. To measure by the thermometer the *quantity* of heat, or its power of producing physical effects, regard must be had to other circumstances besides changes of temperature, viz. the quantity and nature of the substance in which such changes occur; and it is also necessary that the substance should not undergo any other change besides change of temperature. The *British unit of quantity of heat* is so much heat as raises the temperature of one pound of water by one degree of Fahrenheit's scale.

Heat, in its relation to mechanical power, follows laws exactly analogous to those followed by the "energy" or "living force" of a moving body; and hence it has been concluded that it may possibly consist in a whirling motion of the invisible particles of bodies. For example, mechanical power may be expended in the production of heat either by means of friction or of the compression of a gas; and the quantity of heat produced always bears the same proportion to the quantity of mechanical power expended, being *one British unit of heat for every 772 foot-pounds of mechanical power;* that is, so much power as would lift a weight of one pound to a height of 772 feet. Also, in every case in which mechanical work is performed through the agency of heat, a portion of the heat disappears, bearing the same constant proportion, which has been stated above, to the mechanical work performed.

The number 772, expressing that proportion, is called the *mechanical equivalent of heat*, or *Joule's equivalent*, from the name of Dr. Joule, who first ascertained its value exactly.

The illustrations just cited have reference to visible mechanical actions. But heat is also produced and absorbed through invisible mechanical actions, such as those which take place among the particles of bodies when they

undergo changes between the solid, liquid, and gaseous states, or chemical changes.

A change of state of a body is always accompanied by absorption or production of heat. Ice at 0° C., by absorbing heat, melts and becomes water, still at 0° C.; about 140 units of heat disappear for each pound of ice melted. Water, by absorbing heat, evaporates, and becomes steam of the same temperature with the original water. [See STEAM.] Conversely, steam in liquefying gives out heat, which must be carried off or the liquefaction will not proceed. Water in freezing gives out heat, which must be carried off, or the freezing will stop.

In a steam-engine, or any other engine driven by the action of heat on a substance, the expenditure of heat is made up as follows:—

I. Heat expended in raising the temperature of substances;

II. Heat expended in producing changes of the condition of substances, or invisible mechanical effects;

III. Heat expended in producing visible mechanical work; and the *fraction* which expresses the proportion of the third quantity to the whole heat expended is called the efficiency of the engine.

For example, in a steam-engine the expenditure of heat is thus made up:—

I. Heat expended in raising the temperature of the *feed-water* with which the boiler is supplied; also, heat expended in raising the temperature of the air and other external bodies, the latter being the *waste* of heat by conduction, radiation, &c.

II. Heat expended by reason of water, which entered the boiler in the liquid state, being discharged from the cylinder in the state of steam. In a condensing engine this heat is finally employed in raising the temperature of the cold water by which the waste steam is condensed, and might therefore be included under the first head.

III. Heat expended in driving the piston against the resistance which the engine overcomes by means of the expansion of the water into steam, and of the steam to a greater volume.

In all existing engines the efficiency is a small fraction, the highest value of it ever attained having been less than one-sixth, and the ordinary value being much smaller.

Efficiency of a Perfect Engine.—The greatest possible efficiency of an engine driven by the action of heat on an elastic substance between two given limits of temperature, is attained when the whole communication of heat to the substance takes place at the higher limit of temperature, and the abstraction of all the heat not expended in the performance of visible mechanical work at the lower limit; and the value of that efficiency is found by dividing the difference between the two given temperatures by the higher of them, as reckoned from the absolute zero; that is to say from a point 288° C. below the temperature of melting ice, 238° C. below the centigrade zero. A temperature so reckoned is called an "absolute temperature."

Latent Heat of Evaporation.—The quantity of heat which disappears during the conversion of 1 lb. of a given fluid (such as water) from the liquid state to the state of vapour (such as steam), under a given pressure, is found by the following calculation: multiply together the following factors:—

The difference between the volumes in cubic feet occupied by the pound of fluid in the states of liquid and vapour respectively; the change of the pressure of the vapour in pounds on the square foot, corresponding to one degree of change of the boiling point; the absolute temperature at which the evaporation takes place.

The product of this multiplication will be in foot-pounds of mechanical work, and is to be divided by 772 to reduce it to units of heat; and the result is called the latent heat of evaporation. Precisely the same quantity of heat is reproduced by liquefying the same quantity of vapour under the same pressure.

Accurate experimental data (due chiefly to the labours of M. Regnault) had for a long time existed, as to the pressure of steam at different temperatures, and as to the latent heat of a given weight of steam at different temperatures [see STEAM]; but until a comparatively recent time no exact experiments had been made on the volume of a given weight of steam. The law just stated was therefore applied in an inverse form, to compute the volume of a pound of steam, in the following manner:—

Multiply the latent heat, in British units, of a pound of steam produced under a given pressure, by 772, to reduce it to foot-pounds of mechanical energy:

Divide the product by the absolute temperature in degrees, and by the rate at which the pressure in pounds on the square foot changes for each degree of change in the boiling point; the quotient is the difference between the volume of 1 lb. of steam at the given pressure, and the volume of 1 lb. of liquid water, in cubic feet.

(The volume of 1 lb. of liquid water is about 0·016 of a cubic foot, and for most practical purposes may be neglected in comparison with that of 1 lb. of steam.)

The following are some examples of the results of such calculations. For the sake of convenience, the pressures are expressed in pounds on the square inch, that being the ordinary unit of pressure employed in practice.

The volumes of steam thus computed theoretically by anticipation, were afterwards found to agree very closely with those ascertained by the experiments of Messrs. Fairbairn and Tate; and similar calculations have been verified for other fluids.

Temp. Cent.	Absolute Temp. Cent.	Pressure, lbs. on the square inch.	Latent Heat of 1 lb. of Steam, in British units.	Volume of 1 lb. of Steam, cubic feet.
0°	238°	0·085	1092	3390·0
20	258	0·333	1067	934·6
40	278	1·06	1042	312·8
60	298	2·88	1016	122·0
80	318	6·86	991	53·92
100	338	14·70	966	26·36
120	358	28·83	941	14·00
140	378	52·52	915	7·973
160	398	89·86	889	4·816
180	418	145·8	863	3·057
200	438	225·9	837	2·025
220	458	336·3	810	1·393

Relation between Pressure and Volume.—It has been found by trial that within the limits which occur in ordinary practice, the pressure of steam varies nearly as the density multiplied by its own sixteenth root.

The density or weight of a cubic foot of steam at 100° C., is the reciprocal of the volume of 1 lb.; that is to say,

$$1 \div 26{\cdot}36 = 0{\cdot}038 \text{ lb.};$$

and its pressure is 14·7 lbs. on the square inch.

To find, with sufficient accuracy for ordinary practice, the pressure of steam of any other density, divide that density in pounds to the cubic foot by ·038; multiply the quotient by its own sixteenth root, and by 14·7; the product will be the required pressure in pounds on the square inch.

Ordinary way of Stating Pressures of Steam.—The ordinary way of stating the pressure of steam is by the

number of pounds on the square inch shown by a pressure-gauge on the boiler, being the difference between the pressure of the steam and the pressure of the atmosphere. The *real* or *absolute* pressure of the steam is greater by an amount equal to the atmospheric pressure, which varies very considerably, but is estimated on an average at 14·7 lbs. on the square inch. When the pressure of steam falls below the pressure of the atmosphere, the difference of pressure is called *vacuum;* thus, if the atmospheric pressure is 14·7 lbs. on the square inch, the statement that in a vessel containing steam there are 10 lbs. of vacuum, means that the absolute pressure of the steam in that vessel is 4·7 lbs. on the square inch.

Expansive Working of Steam.—When a given weight of steam is in the act of passing from a boiler into a cylinder containing a piston, it drives the piston before it through a space equal to the volume of the steam, and through a distance equal to that volume divided by the area of the piston; and in so doing, the steam performs mechanical work to the amount found by multiplying together the following factors:—

The absolute pressure of the steam in pounds on the square inch; the area of the piston in square inches; the distance travelled by the piston in feet—the product being the work in foot-pounds.

In order to get the greatest possible amount of work from the steam, its action on the piston should not stop here, but after its admission into the cylinder has been stopped or "cut off," so that no more steam can enter the cylinder, the steam already in the cylinder is to be allowed to expand, continuing to drive the piston before it, with a continually diminishing pressure; and this expansive working will continue to add to the useful work until the pressure of the steam falls so low as just to balance that of the waste steam on the other side of the piston, together with the friction of the engine; if carried beyond that point, useful work is wasted instead of gained. To carry the expansion to the limits of usefulness requires a large cylinder.

The proportion in which the volume of the steam at the end of the stroke is greater than its original volume is called the *rate of expansion.*

The work performed during the expansive action of the steam may be computed by dividing the whole distance travelled by the piston into a number of short distances; finding the mean pressure of the steam, and performing the multiplication above described, for each such short distance; and adding the products together. Another method is to find the series of pressures for a series of equal divisions of the whole distance travelled by the piston; find the *mean of those pressures,* and multiply it by the area of the piston and the whole distance travelled; and this is the method followed when the pressure of the steam in an actual engine is ascertained by means of a self-registering instrument called the *indicator.* The exact law of the ratio in which the mean pressure of the steam is less than the pressure of admission at which it enters the cylinder is very complex. The following rule for computing it nearly enough for practical purposes is taken from Rankine's work already quoted:—Divide 16 by the sixteenth root of the rate of expansion; subtract the quotient from 17; divide the remainder by the rate of expansion—the result will be the ratio required, which, being multiplied by the pressure of admission, will give the mean absolute pressure very nearly. Another approximate rule is as follows:—To the hyperbolic logarithm of the rate of expansion, add 1; divide the sum by the rate of expansion; the quotient is the ratio of the mean absolute pressure to the pressure of admission nearly.

In computing the indicated power of an engine, the back-pressure with which the waste steam, escaping from the cylinder after having done its work, resists the motion of the piston, is to be subtracted from the mean absolute pressure already mentioned, so as to leave the effective pressure, as it is called, which being multiplied by the area of the piston and its mean speed in feet per minute, gives the indicated work per minute; and this, being divided by 33,000, gives the indicated horse-power.

The back-pressure is ascertained in actual practice by the indicator. In condensing engines it may be estimated on an average at from 3 to 5 lbs. on the square inch; and in non-condensing (commonly called "high-pressure") engines, at from 16 to 18 lbs. on the square inch in ordinary cases (including the atmospheric pressure).

The *useful* or *effective* power of an engine is usually about four-fifths of the indicated power, the remaining fifth part being wasted in overcoming friction, working valves, pumps, &c.

The total resistance overcome by a steam engine at a uniform speed, whether arising from the useful work or from causes of waste of power, regulates the mean effective pressure, which must be just sufficient to balance that resistance; the mean effective pressure added to the back-pressure gives the mean absolute pressure; the mean absolute pressure, divided by the proper ratio (computed, as already stated, from the rate of expansion), gives the pressure of admission; the mean speed of the piston depends on the volume of steam of that pressure which the boiler is capable of supplying in a given time, and is equal to that volume in cubic feet multiplied by the rate of expansion, and divided by the area of the piston in square feet.

The pressure in the boiler exceeds the pressure of admission in the cylinder in a ratio which varies from once and a twelfth to double in different engines. The difference of pressure is employed in overcoming the resistance of the steam-pipe, valve-ports, &c., to the motion of the steam and forcing the steam through those passages at a high speed. During the expansion which accompanies this fall of pressure, the temperature of the steam falls very little, because the greater part of the heat which at first disappears during the expansion, is reproduced by the mutual friction of the particles of steam as their high velocity subsides. This is always the case when a gaseous substance expands without performing mechanical work, as Professor Thomson and Mr. Joule have proved by experiment.

Additional Heat Consumed by Expansive Working.—It has already been stated that all mechanical effects produced by heat cause heat to disappear. During the expansive working of steam upon a piston the disappearance of heat is so great as not only to lower the temperature of the steam to the boiling points corresponding to its falling pressures, but also to condense a portion of the steam. The presence in the cylinder of the liquid water thus produced is very hurtful to economical working; and it is therefore necessary to supply the steam with enough additional heat to prevent the liquefaction of any considerable portion of it. This may be done in three ways: by means of Watt's "steam-jacket"—an iron casing surrounding the cylinder, kept full of steam from the boiler, and itself cased in felt and wood to prevent loss of heat by conduction and radiation; by surrounding the cylinder with a hot-air flue; or by introducing the steam at first in a superheated state. The heat expended for this purpose must be added to the total heat of evaporation of the steam in computing the expenditure of heat by the engine.

The whole expenditure of heat upon the steam follows laws which are very complex in their exact expression. The following rule is given in the work already quoted for computing it approximately in ordinary cases:—

"Divide the absolute pressure of admission in pounds on the square inch by the rate of expansion; multiply the quotient, in non-condensing engines, by 14, and in condensing engines by 15; to the product add the mean absolute pressure during the stroke; multiply the sum by the area of the piston in square inches, and by its mean

speed in feet per minute: divide the product by 772 (Joule's equivalent), the result will be the number of *units of heat per minute expended on the steam*, or the *available heat per minute*."

The *efficiency of the steam* may be computed by dividing the indicated work per minute by the above-mentioned product (taken before dividing it by 772); for that product is the mechanical equivalent of the whole heat expended on the steam. The efficiency of the steam lies between the limits ·02 and ·2 in extreme cases, and ·04 and ·125 in ordinary cases.

The *total heat expended* is greater than the heat expended on the steam, or available heat, in a ratio which varies from about once and a seventh to nearly double, according to the economy or wastefulness with which the furnace works; and the reciprocal of that ratio, or the efficiency of the furnace, varies from ·5 to ·875.

The total heat produced by the combustion of one pound of coal ranges from 9000 to 15,000 British units, and sometimes even more, according to the quality of the coal.

Multiple-cylinder Engines.—In an engine which works expansively, the strength of every part has to be adapted to the greatest pressure of the steam, while the power depends on the mean pressure only; so the greater the expansion the stronger must the engine be made for a given power. To diminish this practical disadvantage double, triple, and even quadruple-cylinder engines are used, in which the steam commences its action, when its pressure is at the highest, upon a small piston, and completes its action on a large piston. The strain upon the engine is thus made more nearly uniform than in a single-cylinder engine. The work of a given quantity of steam and the expenditure of heat are precisely the same in both kinds of engine, with the same pressure and expansion; but the expansion of steam at a very high initial pressure is much more perfectly carried out in a well-designed engine of two or more cylinders.

Economy of Fuel.—The most usual and convenient method in practice of expressing the efficiency of a steam engine is to compare the consumption of fuel in pounds per hour with the indicated horse-power. To show what relation the result of this comparison bears to the efficiency, as expressed in the previous divisions of this article, the following example may be taken:—

	British units.
Total heat of combustion of one pound of the coal employed, ...	12500
Efficiency of the furnace, ...	0·56
Available heat per pound of coal, . .	7000
(This corresponds to an evaporating power of 7000 ÷ 966 = $7\frac{1}{4}$ lbs. of water evaporated at 212° by each pound of coal.)	
Efficiency of the engine, ...	0·125
Heat expended in mechanical work, per pound coal, ...	875
Mechanical equivalent of a British unit of heat, ...	772 ft.-lbs.
Indicated work or "duty" of one pound of coal, ...	675,500 ft.-lbs.

One indicated horse-power being 1,980,000 foot-pounds per hour, we have for the consumption of coal in pounds per indicated horse-power per hour—

$$1{,}980{,}000 \div 675{,}500 = 2{\cdot}93.$$

The ordinary consumption of coal per indicated horse-power per hour varies from 2 to 7 or 8 lbs. in different engines, according to the efficiency of the engine and furnace and the quality of the coal.

Nominal Horse-power.—Steam-engines and boilers are often bought and sold at a certain rate per nominal horse-power. The nominal horse-power of an engine is a somewhat complex way of describing the dimensions of the cylinder. The rule for computing it varies in different localities, and in the practice of different engineers. The following, however, is one of the most generally adopted rules for condensing engines:—

Multiply the square of the inside diameter of the cylinder in inches by the cube root of the stroke in feet, and divide by 60.

This rule is equivalent to assuming that the mean useful resistance is equivalent to 7 lbs. per square inch of piston, and that the mean speed of the piston is equal to 128 feet per minute, multiplied by the cube root of the stroke in feet.

According to the early practice of Watt, the nominal and indicated power of engines nearly agree; but at the present time the indicated power is greatly in excess of the nominal power.

For non-condensing engines the rule is the same, except that the usual divisor is 20 instead of 60.

Nominal Horse-power of Boilers.—The nominal horse-power of a boiler is a mode of describing its dimensions. The rule for finding it is, to *take one-third of a mean proportional between the area of the fire-grate and the area of heating surface, both expressed in square feet.*

The principles of the action of the steam-engine having been stated, there will now be given a description of the parts and fittings.

A *steam-engine*, in the sense in which it is considered in this article, is an apparatus for converting heat into mechanical work. A given mass of steam is inclosed in the cylinder of an engine behind the working piston; the steam inside the cylinder gives up part of its motion to the piston, and its temperature falls by reason of the conversion of heat into external work, and it is a necessary property of the steam-engine that it must continually return to a starting point, and repeat all its operations over again. It is important here to remember that it is impossible to obtain the whole work contained in the confined mass of steam until by expansion its volume becomes infinite, that is, an expansion to the absolute zero of temperature, and therefore the theory that 1 lb. of carbon during combustion gives out heat sufficient to perform the work of raising 772 × 14,500 lbs. through one foot becomes only a conception of the mind, and is not carried out in practice. Although the practical obstacles which stand in the way cannot be overcome, they may be largely compensated by an arrangement which admits of a deposition and a taking up of heat within the furnace flues, so that the least possible amount is wasted. This arrangement consists of an apparatus termed a *regenerator*, composed of a number of open fire-bricks exposing a large surface for the absorption of heat, so that the end of the regenerator nearest to the furnace reaches a very high temperature, while the chimney end remains comparatively cool. By reversing the draught, the air for supplying combustion in the furnace passes through the heated regenerator, and the waste gases are carried into a second cool regenerator, which again abstracts their heat as described, as shown in the cut, the furnace being supplied with heated air from the hot regenerator.

Steam-engines are divided into two great classes, *condensing* or low-pressure engines, and non-condensing or *high-pressure* engines. The high-pressure engine, though not so efficient in point of economy in fuel, from its comparative compactness and greater simplicity of working parts, is very largely employed, especially where the motor requires to be portable, as on quays and wharves, in connection with the hoists for loading and unloading vessels, and in locomotives.

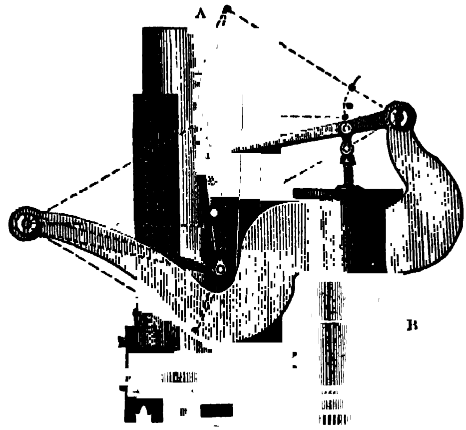
The first point in connection with a steam-engine is to understand the mode of estimating the value of the work performed. Work is performed by a force, when some resistance is overcome, and the point of application of the force is continually moving in face of the resistance. When the force is constant and the direction of motion is in the line of direction of the force, the work performed will be expressed by the product of the force or resistance into the space described, and as the unit of work is the work done in lifting one pound through a height of one foot—or a foot-pound—the number of units of work performed in a given time is a measure of the efficiency of the agent employed. The standard of measurement in estimating the work performed by a steam-engine is called a *horse-power*, representing 33,000 foot-pounds. When an engine is at work a considerable time its performance is called the *duty*, and represents the number of millions of pounds raised through a height of one foot by the combustion of 112 lbs. coal. This mode of measurement is not, however, always convenient, and it is now the practice to value the performance of an engine by estimating the number of pounds weight of coal burnt per hour for each horse-power at which the engine is working. An ordinary performance of a steam-engine is to burn 4 lbs. coal per horse-power per hour. The duty of an engine therefore, burning 112 lbs. of coal per hour, will be as follows:—

4 lbs. coal performs the work represented by $60 \times 33{,}000$, or 1,980,000 foot-pounds per hour. Consequently 112 lbs. does the work represented by $1{,}980{,}000 \times 28$ foot-pounds, and the duty of the engine $= 55{,}440{,}000$ foot-pounds.

From this it follows that the duty of an engine which consumes 1 lb. of coal per horse-power per hour is four times as great, and will be represented by about 222,000,000 foot-pounds. By this means the progress made in the economy of fuel by successive improvements in the steam-engine may be readily traced. In Watt's early engines he consumed 8·3 lbs. coal per hour, but by successive improvements he reduced the consumption to 2·7 lbs. per hour. In the same way, before the year 1863, the average consumption of coal in the best marine engines was $4\frac{1}{4}$ lbs. per horse-power per hour. In less than ten years this consumption had been reduced to an average of 2·11 lbs., being a saving of close upon 50 per cent., and still more recently a further saving has been effected by increasing the steam pressure upon marine boilers to 150 lbs. per inch.

The Indicator.—The original form of indicator devised by Watt for measuring the work performed by an engine was soon found to be unsuitable for general use, and the flat board upon which the indicator pencil traced the pressure curve has been replaced by a cylinder (A, fig. 5) inclosing a spring. This cylinder, round which a sheet of paper is wound, is caused to move backwards and forwards through a part of a revolution, so that its motion corresponds with that of the piston in the cylinder of the steam-engine. The small indicator cylinder, B, contains a piston and rod, acted upon by the pressure of a spiral spring. When the steam is admitted into the cylinder below the piston this spring is compressed, as its elasticity resists the pressure of the steam which tends to force the piston up. When the pressure of steam below the piston of the indicator equals that of the atmosphere the spring is neither compressed nor extended, but when the pressure falls below that of the atmosphere during the time the steam is being condensed, the atmospheric pressure forces down the piston of the indicator until it is balanced by the tension of the spring. The extension or compression of the spring therefore measures the difference between the pressure of the atmosphere and that of the steam in the cylinder of the engine. To the upper extremity of the piston-rod a series of levers are attached, carrying a pencil which presses on the paper as it moves, tracing a curve which represents the pressure of the steam at every point of the piston's motion, as shown in fig. 5.

Fig. 5.



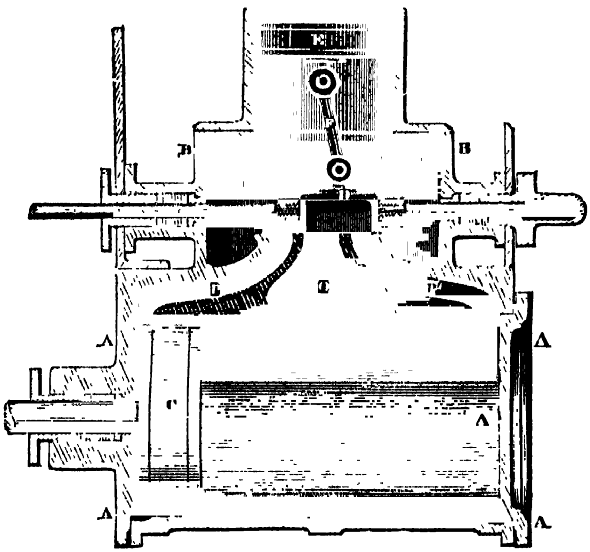
Richard's Indicator.

Steam Valves.—In all steam valves, the most important element is the combination in some form of the slide valve, originally devised in 1799 by William Murdock, as an improvement upon the steam valves employed by Watt in his double-acting engine.

In examining the construction of the slide valve of a steam-engine (fig. 6) it will be noticed that the arch of the valve, D, exactly bridges over the edges of the space between the two inner edges of the two steam ports, P, P′, but that the sliding faces of the valve considerably overlap the ports on the two outside edges; this is termed the *lap* of the valve, and regulates by its extent the opening of the port when steam is to be admitted, which is often less than the whole breadth of the opening, and, *vice versa*, gives a larger opening for the rapid passage of steam from the cylinder into the condenser. Thus the lap of the valve regulates the breadth of opening of the same passage for both the entrance and exit of the steam. The necessity of placing lap on a slide valve will be understood by considering what would take place without it. If there were no lap the steam port could only be perfectly closed at the instant that the valve was in the middle of its stroke, at which time it would be moving most rapidly. Such a valve would be quite unsuitable for an engine. By the lap arrangement the steam becomes compressed as a cushion on one side of the piston, assisting in bringing it to rest, while the driving pressure on the opposite side is relieved by opening a passage to the exhaust, O, and releasing the steam just before the stroke terminates, as shown in the figure, thus preventing the violent strain upon the crank pin if the piston were urged with full momentum upon the crank at the dead points. The practical effect, therefore, of lap on a slide valve is to produce a fixed amount of expansive working, and the amount of lap which should be allowed in order to cut off the steam at any part of the stroke is a simple matter of calculation. In practice it is a rule to open the steam port at the instant before the piston comes to the end of the cylinder, so as to admit steam into the space where the cushion of steam is: this anticipation or lead of the motion of the piston is termed the *lead of a valve*. Thus a strong pressure is brought against the piston at the moment it is reaching the end of its motion in one direction, and the strain upon the crank pin is proportionally reduced. The more rapid the motion of the piston, the greater the importance of giving lead.

Murdock's valve, technically termed a D-valve, consists of a hollow pipe D (fig. 6), generally semicircular in shape in its transverse section, and attached to a rod as shown. On the flat side of the pipe are two plane faces, which slide upon corresponding plane surfaces, having openings, termed *ports*, P, P′, which form passages into the cylinder A A, and convey the steam to either side of the piston, C. The length of the hollow pipe is so

Fig. 6.



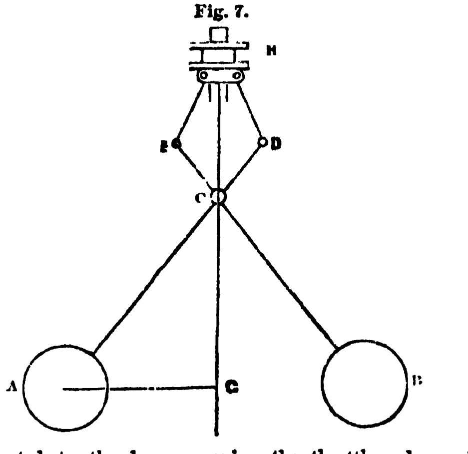
adjusted that when one port is closed the other remains open. The sliding surfaces of this valve are as nearly as possible true planes, so as to render the valve steam-tight on the plane side. The valve is kept in contact with the surface on which it slides by the pressure of the steam on the back, but in some engines this has to be reduced by some such arrangement as is shown in the cut, where the pressure on the piston, E, is adjusted so as partly to balance that on the valve D by means of the link F. Any steam which enters the steam chest, B B, will pass freely into the cylinder through the port P, so long as the port P′ remains open and admits of the spent steam finding its way through the outlet O to the condenser.

Eccentric.—The slide valve of an engine is usually actuated by the employment of what is termed an eccentric, which produces a uniform and automatic motion to and fro in stated periods of time, regulated by the working speed of the engine. The eccentric consists of a circular metal disc attached to the axle of the fly-wheel or main driving shaft of the engine, so that the centre of attachment shall not be concentric but eccentric with that of the centre of the disc—the amount of this eccentricity being in proportion to the distance required of the backward and forward throw of the eccentric rod. In a groove cut round the periphery of this disc, two semicircular pieces of metal are fixed together by bolts completely encircling the disc, and are so adjusted as to slide over the circumference of the disc upon its revolution. On a rod being attached to this hoop the end of the rod partakes of a reciprocating motion in both directions. The distance traversed is termed the *throw of the eccentric*, and the value of the eccentric arises from the circumstance that it enables motion to be derived from any part of a shaft, whether at the end or not, without forging a crank upon the shaft or subdividing it.

Governor and Fly-wheel.—The regulation of the speed of an engine is generally effected to a certain extent by mounting on the main shaft a large wheel of cast-iron called the *fly-wheel*, usually found in all driving engines. When there is excess of velocity, the mass of the fly-wheel absorbs the excess of motive power from the form of moving force, and restores it to the various parts of the engine when the speed relaxes.

The value of a fly-wheel is not realized unless the velocity is at times greater, and at others less, than that of the normal velocity. Should the velocity be always in excess the fly-wheel would be of no use, as this excess may go on increasing up to breaking point, and therefore it is necessary to employ another kind of regulator, the *centrifugal* regulator, or governor, by the aid of which the engine itself regulates its velocity should the steam leave the boiler with an excess of pressure, or should the steam not arrive in sufficient quantity, and the velocity of the motion be diminished. This form of regulator consists of two metallic balls, A B, carried by two rods jointed to a fixed point, C, on a vertical axis, G. Two other rods, jointed at D and E to the rods carrying the balls are attached to a collar H, which clasps the vertical axis and slides up and down along it. The whole of this arrangement is caused to rotate by the driving shaft of the engine. The collar is clasped by a fork forming one of the ends of a lever in connection with the throttle valve in the steam-pipe. When the engine is working with its regular velocity this lever remains horizontal; if the velocity increases, the centrifugal force increases the distance of the balls from the axis, and the collar in consequence rises, and with it the forked end of the lever, so that the other end, being depressed, closes the throttle valve in a corresponding degree, thus diminishing the amount of steam entering the cylinder. If, on the other hand, the speed of the engine diminishes, the centrifugal force is less, the balls approach the axis, the collar is depressed, and an opposite motion is

Fig. 7.



imparted to the lever, opening the throttle valve and admitting more steam.

In Plate I. are shown the principal types of stationary engine, condensing and non-condensing, in use in this country—the horizontal-cylinder type being most economical of space, but apt to cause unequal wear in the interior of the cylinder. Plate II. is an example of a large-sized condensing beam-engine of modern type, as employed for supplying the air to a blast furnace.

For a description and example of a modern marine engine, see article and Plate STEAM-VESSEL; and of locomotive engines, see article LOCOMOTIVE and Plates.

STEAM-HAMMER. See HAMMER.

STEAM-VESSEL. A vessel fitted with a steam-engine to drive the propelling apparatus is called a steam-vessel. The propellers may be paddle wheels, screws, or jets of water ejected from the vessel. The thrust exerted by a propeller produces a reaction which forces a vessel to move in a direction opposite to that in which the thrust is delivered, the vessel's speed being dependent on the relation between the thrust and the resistance to be overcome. Steam navigation has conduced largely to the necessities and comforts of mankind, in the rapid and regular means of communication which it affords with all parts of the globe. Unlike sailing ships, steamers are to a great extent independent of the wind and weather in performing their voyages.

The early history and development of steam propulsion has frequently been described. Professor Woodcroft, in his "Origin and Progress of Steam Navigation," has given one of the most complete accounts of the subject, and several interesting details may be found on referring to his book. Paddle wheels worked by manual labour were employed as propellers in remote times. A Spaniard, named Blasco de Garay, is said to have attempted to use steam power for driving paddle wheels in 1543. In the seventeenth century many inventions were patented in this country with the object of propelling vessels by means of steam power. None of these, however, were attended with any immediate practical results. Dr. Papin, a Frenchman, contrived in 1681 to give rotary motion to a paddle wheel by means of a rack on each side of two piston rods, so arranged as to act on pinion wheels fixed on the paddle shaft. In 1705 Newcomen, by combining Papin's arrangements with Savery's plan for the condensation of steam in the cylinders, made a comparatively efficient propelling apparatus. Next in order of time, Dr. Allen suggested in 1729 that a jet of water ejected from the stern could be used as a propeller. The principle was practically developed in 1843 by Mr. Ruthven of Leith, but as yet it has not been attended with efficient results when compared with those obtained from the more generally employed paddle-wheel and screw propellers.

In 1736 Jonathan Hulls patented a plan for driving two paddle wheels at the stern by means of ratchet work connected by chains or ropes to an atmospheric engine. The introduction of the crank shaft, connecting rod, and fly wheel by Pickard in 1780, together with the separate condensing double-acting engine of James Watt in 1769, surmounted the chief difficulties which then retarded the progress of the art of steam propulsion. Not till 1801, however, was the rotary engine of Boulton and Watt practically applied to this purpose. In 1781, at Lyons, the Marquis de Jouffroy constructed a steamer 140 feet long with paddle wheels, but the results obtained do not appear to have been so successful as to lead to a continuance of his plans. Miller, Taylor, and Symington conjointly succeeded in propelling a pleasure boat at the rate of 5 miles an hour, on Dalswinton Loch, in 1788. The boat was of twin form, and was driven by paddle wheels with steam power. Profiting by the experience gained from the experiments made with this boat, Symington in 1802 built the stern-wheel steamer *Charlotte Dundas*, which has been described as "the first practical steamboat." She was employed on the Forth and Clyde Canal with satisfactory results, but after a time her runs were discontinued because the proprietors of the canal were apprehensive of damage to the banks from the wash of water she caused. Fulton, an American, after visiting this country and making himself acquainted with what had been done in steam propulsion, built in 1807 the paddle-wheel steamer *Clermont*, for American river service. She was 130 feet in length, and her engines were made by Boulton and Watt. In 1808 Stevens built a paddle steamer which he successfully navigated from the Hudson to Delaware River, and so became the first person who took a steamer to sea. For regular passenger service in this country the first steamboat was the *Comet*, built in 1812 for Henry Bell, to ply on the Clyde. Her length was about 40 feet, she was fitted with two pairs of paddle wheels, and she attained a speed of 7½ miles per hour. The American paddle-wheel steamer *Savannah* was the first to steam across the Atlantic, which she did in 1819, with the aid of her sails, in twenty-six days from New York to Liverpool. In 1838 the historically famous paddle steamers *Sirius* and *Great Western* crossed from England to America in seventeen and fifteen days respectively. Their average speed was about 8 knots per hour. It may be said that these vessels established the practicability of steamers making long ocean voyages. Steam paddle vessels of increased size and power were built soon after this. The introduction of "feathering" paddle wheels by Galloway in 1829 was a notable improvement on the efficiency of this kind of propeller, although fixed blades on paddle wheels are still commonly used.

The screw as a propeller appears to have been suggested by Daniel Bernoulli in 1752. It was, however, reserved for Ericsson (a native of Sweden) and Smith to develop its use practically in 1837. Previous to this the paddle wheel was almost the only kind of propeller used. The first vessel of notable size fitted with a screw was the *Archimedes*, 232 tons, in 1839. Since then the paddle wheel has been gradually displaced by the screw for ocean service. It was not till 1860 that the Atlantic steamship companies adopted the screw generally, although the Inman Line started in 1850 with the screw steamer *City of Glasgow*, 1680 tons. The paddle steamer *Scotia*, 369 feet long, was built in 1861 for the Cunard Co., and she attained a speed of 15 knots per hour on the measured mile. Her average time from Queenstown to New York was about nine days. Some interest attaches to the *Scotia* as being the last large paddle steamer built for the Atlantic trade. In 1862 the government of this country approved of the mails being carried in steamers propelled by screws.

It was a question much debated fifty years ago whether it was practicable for steamers to perform long ocean voyages and at the same time remunerate their owners—chiefly because of the quantity of coals required to be carried. This question has now, we know, been answered affirmatively by many years of successful experience, and the difficulties then felt have been gradually removed by improvements in the marine engine and in the forms of ships. Development in the size and speed of screw steamers has been very rapid during the last ten years. Greater efficiency in the performance of the propelling machinery, with diminished consumption of coal, have been the results of improvements rather than by the introduction of new principles, and now long ocean voyages are made at speeds of from 15 to 18 knots per hour. The opening of the Suez Canal shortened the distance by sea between this country and the East Indies and China, and gave considerable impetus to the growth of trade for steamers.

War ships were not fitted with screw propellers until some time after the latter were successfully employed for mercantile purposes. The earliest ships of the Royal Navy so fitted had very full forms at the stern, which greatly interfered with the efficient action of the screw, and the maximum speed they attained was only 9 or 10 knots per hour. In more recent years the fore and after ends of war vessels have been formed much finer, and the screw has given more satisfactory results. There are several ships of the Royal Navy that can steam 15 or 16 knots per hour, and the fastest have a speed of over 18 knots.

With the speed the length of steamers has also in-

creased. Scott Russell has the credit of first recording that for a certain speed to be attained without undue exertion of propelling power a vessel should not be shorter than a certain length, which is dependent on the speed. A maximum speed of 10 knots per hour, for example, is appropriate to a vessel of about 100 feet in length, of 15 knots to a vessel 225 feet long, and so on; or the square of the speed in knots per hour gives approximately the suitable length for the vessel intended to have that speed as a maximum. The additional power found necessary to propel a vessel at a higher speed than that suitable to her length is much greater than the extra power required for a similar increase on a speed taken below her proper maximum speed. What follows on the subject of resistance may serve to show why this is so.

The early theories respecting the resistance to vessels moving through water were for the most part founded on experiments made with plane surfaces, drawn either directly or obliquely through water. But no allowance was made for that part of the resistance caused by the eddying wakes formed at the back of such a plane, and in consequence of this the actual resistance to a ship-shape form was only very roughly approximated to. The late Professor Rankine and Mr. Froude have done much to extend our knowledge of resistance by means of the now adopted stream-line theory. This theory, however, does not yet afford a complete quantitative solution of all the problems connected with the resistance of ships, nor do we yet know the exact paths of the particles of water as they flow past a vessel.

If we suppose a smooth ship-shaped body to be deeply immersed in a frictionless fluid of unlimited extent flowing past the body, the fluid particles between consecutive stream-lines will remain in the same elementary stream, bounded by the stream-lines throughout their motion past the body. In such a fluid, with the other conditions named, the sum of the pressures on the forward part of the body balance those on the after part, and the body will remain at rest. In actual practice these conditions are unattainable, for no fluid is absolutely without friction, nor no body quite smooth, and further, the depth and extent of water must have limits. The stream-line theory, however, affords the means of analyzing and comprehending to a considerable extent the laws which govern the resistance to a vessel's motion through water. Friction of the particles of water on each other and on the surface of the vessel's bottom are important elements of resistance. Ordinarily, too, a vessel is only partly submerged, and surface disturbance or wave-making, which could not be produced in the hypothetical case of the deeply submerged body, is now another important part of the resistance to motion. Finally, an appreciable portion of the total resistance arises from the eddying wake at the stern, which is principally due to the frictional drag impressed on the particles of water as they pass along the surface of the vessel, and is increased by the existence of abrupt changes of form, especially at the after-end.

According to the modern theory, then, the total resistance is resolved into three parts: (1) surface friction, (2) wave-making, (3) eddy-making. Careful experiments show that surface friction is directly dependent on the area of the immersed surface, on the length of the surface, on the degree of its smoothness, and, finally, on the square of the speed of advance. Taking the case of an ordinary shaped iron vessel with a clean painted bottom, at moderate speed in relation to the length, Mr. Froude estimated that the surface friction amounted to from 50 to 70 per cent. of the total resistance, or that at 13 knots in such a case there is a resistance of one pound per square foot due to friction. If the bottom of the vessel be foul this amount may be doubled. Eddy-making in vessels of good form at the stern offers about 8 per cent. of the total resistance, according to the same authority. This is much increased by bluntness or changes of form at the stern interfering with the natural flow of the converging streams.

Wave-making, or surface disturbance, is influenced more by the dimensions and form of a vessel than the other two parts of the resistance are, for let us consider what takes place as the water flows past a vessel supposed to be held at rest. In meeting the bow or "entrance" the particles are forced out laterally, and their speed consequently slackened. This produces a heaping up of the water, or a wave, on each side of the bow. When passing the parallel sides of the middle portion of the vessel's length the speed of the particles becomes accelerated, and we consequently find a wave hollow there. The converging form of the stern or "run" of the vessel again causes retardation of the speed, accompanied by a wave-crest, as at the bow. Obviously the same series of results would follow supposing the vessel in motion through still water. In ordinary cases, then, the wave disturbance is generally of the character described where there is no screw or other propeller to modify the direction and speed of the streams. Screws or paddle wheels considerably affect the heights, positions (relatively to the vessel), and numbers of the waves. The energy expended in creating the bow and stern waves produces an augmentation of the resistance, notwithstanding that the two partly counterbalance each other. But the thrust of a screw propeller on the stern wave considerably reduces the forward pressure of that wave, and so increases the resistance to be overcome.

Formerly it was commonly accepted that a broad vessel experienced greater resistance than a narrow one of the same length and depth. This, however, is not necessarily the case. With long and fine entrance and run the broad ship may be made to have the same displacement as the narrow ship with full ends. In consequence of the suitably shaped ends the wave-making part of the resistance in the case of the broad ship would be less than that of the narrow ship, while the frictional resistance would be about the same for both. So that the total resistance may actually be less for a broad than for a narrow vessel. Within certain limits this has been shown to be so, from experiments made by the late Mr. Froude with ship-shaped models of various dimensions. It may be of interest to add that the models used were made of paraffin, the forms being accurately shaped by means of special mechanism. The models were towed in a tank of water free from external disturbing influences, and the strains due to towing at different speeds automatically measured and registered by machinery designed for the purpose.

Returning to wave-making resistance, it was observed by Scott Russell that this was largely influenced by the lengths of the entrance and run. The distance from the stern to the foremost transverse section having the full breadths of the vessel is known as the "length of the entrance," and the "length of the run" is the distance from the stern-post to the aftermost section having the full breadths. The minimum length of entrance should not be less than that of a wave whose natural speed is the same as the greatest speed the ship is intended to have. If the entrance has less length than this, a rapid increase in wave-making resistance is the result, for the bow wave being shorter than the natural length for the speed it is driven at, is maintained at the expense of propelling power, which is eventually uselessly dissipated in diverging waves. A similar relation between the length of the run and that of the stern wave is necessary to avoid undue waste of power. Variations in the amount of the wave-making resistance may also arise from differences of form at the ends of a vessel, even after the lengths of entrance and run appropriate to the speed have been provided for. Scott Russell's rules for the lengths of the entrance and run make these vary directly with the speed squared. The total length for a vessel with no straight middle body is,

by those rules, a little less than the square of the speed in knots per hour for the length of the vessel in feet, a rule already referred to. Ordinarily little difficulty is experienced in getting even greater lengths than the above rules require. But there are special steam vessels (principally used for torpedo service) having the very high speeds of from 20 to 23 knots per hour, whose lengths are only one fourth or one-fifth of the length required by the rule. From what has been already stated, it will be seen that these speeds are attained by the expenditure of power abnormally great in proportion to the size of the vessel.

At moderate speeds for the length of a vessel the total resistance varies nearly as the square of the speed, and the power necessary to attain the speed therefore varies as the product of the resistance by the speed, or the speed cubed. Above the limiting speed appropriate to the length the total resistance rapidly increases and varies with higher powers than the square of the speed. A maximum resistance is ultimately reached, after which, as the speed becomes very high, the resistance relatively decreases, and again it varies with even a less power than the square of the speed.

The determination of the steam power necessary to propel a vessel at a certain speed is important in preparing her design, and when taken in connection with the numerous other conditions which have usually to be fulfilled, is a task requiring the most careful consideration.

Different methods are used to arrive at the power required, which are based partly on modern theories of resistance, and partly on the results recorded of actual vessels, for the problem cannot be solved as yet by theory alone. As already stated, Froude has established methods by which the actual resistance to a ship model being towed can be determined with accuracy. To arrive at the resistance to a full-sized ship from that known for its model, he has given his *scale of comparison*. Taking the *corresponding speeds* of the ship and her model to be proportional to the square roots of their lengths, then the resistances of the ship and model at these speeds will be as the cubes of the lengths, subject to readily made corrections on account of the difference in the lengths and smoothness of the surfaces of the ship and her model. Of course this supposes there is no propeller to interfere with the flow of water.

In considering the power of steam engines the unit of measurement taken is one horse-power, equal to the work done in raising 33,000 lbs. through one foot in one minute. The power required to overcome the resistance, or what is equivalent, the tow rope strain, is called the effective horse-power. This is usually only from 45 to 60 per cent. of the indicated power developed in the steam cylinders. The friction of the machinery, the imperfect efficiency of both engine and propeller, and the augment of the total resistance due to the thrust of the propeller on the stern water, all go to make up the difference between the effective and indicated horse-powers. According to the Admiralty formula the horse-power for a certain speed equals the displacement to the two-third power multiplied by the cube of the speed and divided by a constant which is derived from actual results of similar vessels. This assumes that in similarly formed vessels the power varies as the cubes of the speed, and that the useful work of the propelling machinery varies with the power developed. It is a formula generally used, although in some instances it has been modified by embodying in it a measure of the fineness of the entrance. Another Admiralty formula for obtaining the horse-power uses the area of the immersed midship section instead of the function of the displacement, the constant being then modified to meet the change.

Professor Rankine's method of determining the horse-power is to multiply the area of the wetted surface by a coefficient estimated from certain functions of the angles of inclination of the bow water-lines, and again by the cubes of the speed, the product being divided by 20,000 for the case of an iron vessel with a clean painted bottom.

If the towing resistance of the model of a vessel is determined from experiment, the horse-power required can be ascertained by means of the law of comparison, on the assumption that the indicated power would be about twice the effective power. Great care is necessary if this method is used in recording the results of experiments with models, for errors in these become largely magnified in applying them to the full-sized vessel. This law of comparison is also found useful sometimes in estimating the horse-power for a vessel from the recorded performances of one of similar form but of different dimensions.

To keep the consumption of coal as low as possible is also of great importance, not only because of the cost of the coal, but because by diminishing the coal, greater ght of cargo can be carried upon the same draught of water. At low speeds the consumption of coal for a stated distance travelled is less than that at high speeds. Some of the largest and swiftest Atlantic steamers consume more than 300 tons of coal per day, or a little over 2 lbs. per indicated horse-power per hour. In the earliest steamers the coal consumption was at the rate of 9 lbs. per horse power per hour. Recently, with engines of the triple expansion type, the consumption at full speed is said to have been as low as $1\frac{1}{4}$ lb. per horse-power per hour, and we may reasonably expect still further reductions in the future, judging from the past.

Consistent with due strength and efficiency, it is obviously important that the weight of the machinery be as low as possible. Modern marine engines weigh from $2\frac{1}{2}$ to $4\frac{1}{2}$ cwt. per indicated horse-power, and in the large Atlantic steamers, for example, the ratio of the indicated horse-power to the displacement of the vessel in tons varies from one-half to a little more than one. Economical propulsion is more readily secured in large than in small vessels, for the resistance does not increase so rapidly with the lineal dimensions of a vessel as the displacement, and large ships maintain their speeds in bad weather more efficiently than smaller ones.

If we suppose a screw propeller to make a complete revolution in a solid screw nut, the length of the advance is termed the "pitch" of the screw. Now, in exerting its thrust on the water there is less advance than would take place in the solid nut, and the difference in these distances is the "slip" of the propeller. It amounts in ordinary cases to about 20 per cent. of the speed of the screw. The screw "disc area" is the circular area swept out by the screw in a revolution, and the volume of water acted on by the propeller in a unit of time (or the "propeller race") multiplied by its velocity sternwards relatively to still water, is a measure of the thrust of the propeller.

Experience has shown that for ocean service, paddle wheels compare unfavourably with screw propellers, because the variations in the draught of water caused by the consumption of coals and stores, and the rolling and pitching of the vessel in a seaway, affect the efficient uniform working of paddle wheels more than screws. Paddle wheels, too, expend about as much waste work in churning the water as in effectively propelling the vessel. They continue to be employed with advantage for river service, or in other places where shallow water fixes a limit on the draught of the vessel. Some paddle steamers engaged in channel passenger service have the high speed of 18 knots per hour.

Twin-screws—a screw being fitted on each side of the stern—are growing in favour for special cases of shallow draught with high speed, or where quick turning power is required. They compare favourably with single screws driven by the same power, and are being extensively adopted in ships-of-war. If one screw becomes disabled

it is an advantage of no slight importance for the remaining one to be available for propulsion, In the mercantile navy twin-screws have not been generally adopted as yet.

It is estimated that a steamer does on an average four times the work of a sailing ship of the same tonnage in a year. On the other hand, the first cost and cost of maintaining the steamer is considerably greater than that of the sailing ship. Steam propulsion affords the means of performing voyages with more regularity and in less time than is possible when the wind alone is depended on for driving a vessel.

To illustrate the development in the speed of steam vessels to meet the growing requirements of the last fifty years, the voyage from England to America, which took sixteen days in 1838, is now done in seven days; and that to China round the Cape, which formerly occupied three to four months, has been done recently in twenty-seven days *via* the Suez Canal. The voyage to Australia, which used to take several months is now done in from thirty-seven to forty days, and that from the Cape of Good Hope to London has been performed in about eighteen days by fast steamers of modern type. It is customary to test the maximum speed attainable by new steamers under favourable circumstances, by observing the time they take to steam over a measured nautical mile or knot of 6080 feet. Progressive trials at various speeds are also made in a few instances, when careful records are made of the coal consumption and of the performances of the propelling machinery, with the object of gaining the fullest information as to the steaming capabilities of the vessel.

As to the construction, dimensions, proportions, and stability of steam vessels, see the article SHIPBUILDING.

Marine Engine.—A name given to the machinery used for propelling vessels through the water. There are two methods by which this is effected, viz. the paddle-wheel and the screw-propeller. The former is generally used for river traffic, and the latter in sea-going and ocean steamers. The principle, however, whether paddle or screw, is the same, although the design and arrangement of the several parts may be different.

Its modern type is that known as the compound engine, which consists of two cylinders of different diameters, the smaller being the high-pressure, and the larger one the low-pressure cylinder, from the fact that the steam used in the former is at a greater pressure and temperature than that of the low-pressure cylinder. It has for several years been almost universally adopted in the merchant service, but is now being superseded by the triple and quadruple expansive form, whose most favourable feature is economy of fuel, the saving as compared with the ordinary compound engine amounting to 20 per cent. The difference between these consists in the latter having the steam expanded in three or four cylinders instead of two, as in the former case, and whereas the ordinary compound engine works at a boiler pressure of about 80 lbs., the triple expansive engine in many instances works at about 160 lbs. per square inch.

The usual marine engine consists of the following principal parts:—the sole plate, cylinders, pistons, slide valves, eccentrics, crank-shaft condenser, circulating pump, air pump, hot well, feed pump, and bilge pump.

The *sole plate* is a strong iron casting, securely bolted down to the engine seating, and on which cast-iron columns are erected for the purpose of supporting the cylinders, to which they are secured by bolts fitted through holes in their respective flanges. The sole plate is also bolted to the condenser, so that with the latter it forms a base for the engine. Recesses are made in the sole plate for fitting the main bearings, which support the crank-shaft.

The *cylinder* is a vessel accurately bored out in order that the piston may work steam-tight within it. On the front or face of the cylinder are oblong openings, called steam ports, through which the steam enters and returns from above and below the piston.

The *piston* is a metal disc turned to fit the cylinder. It is made steam-tight by a metallic ring, called the packing ring, pressing against the cylinder by means of springs. These are kept in position by the junk ring, which is screwed down by bolts, the nuts of which are fitted in recesses in the piston.

The *slide valves* are used for the purpose of opening or closing the steam ports; these control the entrance or exit of the steam to and from the cylinders; they receive their motion from the eccentrics, which are keyed on the crank-shaft.

The action of the steam in giving motion to the machinery is as follows:—The stop-valve on the boiler and the throttle valve in the steam pipe are opened, then if the slide valves be moved to open the upper steam-port, the steam will rush into the high-pressure cylinder to the upper side of the piston, and the pressure will force the piston down, and with it the piston rod and the connecting rod, which, acting upon the crank pin, will cause the shaft to revolve, and with it the propeller or paddle-wheel. The eccentrics are fitted on the shaft so that they close the steam-port before the piston reaches the end of its stroke, permitting a portion of the work to be done by the expansion of the steam. The lower steam-port is then opened, and the steam forces the piston upwards, and as the exhaust-port has opened, the steam on the upper side finds its way to the second or intermediate cylinder, where the same process is repeated, but in the low-pressure cylinder; the steam having performed its work, passes through the exhaust pipe into the condenser. It will be observed that, in the case of the high-pressure valve, the slide valve is constructed in the form of a piston, because with common slides (such as are fitted to the intermediate and low-pressure cylinders) the pressure would be too great on the back of the valve.

The *condenser* is a rectangular chamber whose function is to condense the steam exhausted from the low-pressure cylinder; this is accomplished by the steam coming into contact with the cold surfaces of a great number of brass tubes, through which the cold sea-water is forced by means of the circulating pump, driven by the main engines, or by a centrifugal pump driven by a separate engine. This type of condenser is termed a surface condenser, as distinguished from the jet condenser, in which the exhaust steam was met by a jet of cold water from the injection pipe.

The *air pump* is used for the purpose of pumping the condensed water and the air from the condenser to the hot well, from whence it is returned to the boiler by the feed pump.

The *bilge pump*, attached to the main engines, is used for pumping the bilge water overboard from the engine-room and other compartments of the vessel. To prevent the pump from becoming choked, perforated boxes are fitted to each suction pipe, so that water only may reach the pump. In case the bilge pump should not be sufficient to free the vessel of leakage, auxiliary or donkey engines are generally fitted for this purpose, also a bilge injection valve, by which means the circulating water for the condenser may be taken from the bilges.

The various parts of the marine engine will be seen on referring to the Plate. H C is the high-pressure cylinder; I C, the intermediate cylinder; L P the low-pressure cylinder; *v*, the slide valve; P, the piston; J, the junk ring; R, the packing ring; *p r*, the piston rod; *c r*, the connecting rod; *c s*, the crank-shaft; *c c*, the cranks; *d*, the condenser; A, the air-pump; S, the sole plate; *e*, the eccentrics; *h*, the hot well; *f*, the feed pump; *b*, the bilge pump; *s p*, the steam ports; *x*, the exhaust port; and *x p*, the exhaust pipe.

STE'ARIC ACID was first discovered by Chevreul. It is found in the solid part of fats, both of the animal and vegetable kingdom, as the principal constituent, and also in smaller proportion in some of the softer fats and oils. Beef and mutton suets and the fat of the cocoa-nut contain it in large quantity, in combination with glycerin; it is also present in butter and in olive-oil. It is easily prepared from suet by saponifying with soda lye, and precipitating the solution with sulphuric or hydrochloric acid. The precipitate is washed with water, and dissolved in boiling alcohol, from which solution the stearic acid crystallizes out on cooling, the oleic acid also present remaining in solution. It crystallizes in shining needles, having about the same specific gravity as water. The crystals are colourless, tasteless, and inodorous, and melt at 69° C. (156° Fahr.) It is insoluble in water, but soluble in alcohol, ether, and oils. The formula is $C_{18}H_{36}O_2$. It combines with alkalies, forming soaps, which are called stearates, and also with metallic oxides. These salts are mostly insoluble, and have the general formula $C_{18}H_{35}MO_2$. Stearic ether or ethylic stearate, $C_{18}H_{35}(C_2H_5)O_2$, is a crystalline substance melting at 33° C. (91° Fahr.), and boiling at 100° C. (212° Fahr.) It is soluble in alcohol and ether. Heated with alcoholic ammonia it produces stearamide ($C_{18}H_{37}NO$). When stearic acid is subjected to dry distillation, stearone ($C_{35}H_{70}$) is formed. It crystallizes in small pearly laminæ, melting at 87·8° C. (190° Fahr.), and soluble in boiling alcohol, from which solution it is deposited on cooling. It is an important constituent of hard soaps and of composite candles, to which it contributes the high melting point.

STE'ARIN, this substance forms the larger portion of animal and vegetable fats. It is a compound of stearic acid and glycerin, or glyceric stearate. There are three stearins, all of which can be produced artificially by heating stearic acid in different proportions with glycerin. Monostearin ($C_{21}H_{42}O_4$) crystallizes in white needles, melting at 61°C. (141° Fahr.); distearin ($C_{39}H_{76}O_5$) crystallizes in white scales, melting at 58° C. (136° Fahr.); tristearin ($C_{57}H_{110}O_6$) crystallizes in pearly scales, melting at 52° C. (149° Fahr.) It is this variety of stearin which forms the basis of the solid natural fats. It may be extracted from suet by boiling in alcohol; on cooling the solution it crystallizes out and may be purified by recrystallization. It is insoluble in cold alcohol, but dissolves in hot alcohol, and also in ether and oils. It is easily saponified by alkalies, a stearate soap of the alkali being formed and glycerin set free.

STE'ATITE. See POTSTONES.

STEEL. This is a compound of iron and carbon, intermediate between cast iron and malleable iron; the best steel which can be tempered and hardened, and which still retains its tenacity, contains 1·5 per cent. of carbon. The presence of either sulphur or phosphorus is particularly prejudicial. For the manufacture of tools it is made by heating bars of iron for a considerable time packed in boxes of charcoal. The manufacture of Bessemer and Siemens steel has been already described under IRON. The so-called soft steel made by these processes is really a pure iron.

Steel is a white metal with considerable lustre. The specific gravity is 7·75; the melting point is about 1800° C. (3272° Fahr.) It is remarkable for its tenacity, which exceeds that of any other metal. It can be easily welded at a white heat. It is tempered by heating and then suddenly cooling it. By this means it becomes extremely hard. Raised to a white heat and then dipped in cold mercury, it acquires a hardness nearly equal to that of the diamond, but it is then extremely brittle. When heated and slowly cooled it again becomes soft. For different purposes it is heated to different degrees, and then suddenly cooled in water or oil. The temperature desired is indicated by varying colours assumed by the metal, and which are due to a film of oxide. These are as follows:—

Temperature. C.	Fahr.	Colour.	Purpose.
220°	428°,	Faint yellow, .	Surgical instruments.
230	446,	Straw yellow, .	Razors, penknives.
255	491,	Brownish yellow,	Scissors, chisels
265	509,	Purple spots, .	Axes, knives.
277	550,	Purple, . . .	Table knives.
288	550,	Pale blue, . .	Sword-blades, watch springs.
293	559,	Dark blue, . .	Fine saws, boring tools.
316	600,	Black blue, . .	Hand saws.

Steel retains magnetism better than iron, and is generally employed for making magnets. It does not tarnish on exposure so readily as iron, and is not so easily acted on by acids. It is completely soluble in concentrated hydrochloric acid.

STEEL ENGRAVING. As far as regards facility of execution, whether by etching or by cutting with the graver, probably no material could be found superior to copper, which is still preferred by many engravers where the bold and free character of the work is more important than the durability of the plate; but it is found that more delicate work can be executed on steel, and greater brilliance in printing obtained from such a plate.

The introduction of the modern art of steel engraving appears to be attributable, in a considerable degree, to the interest which existed in the subject of preventing the forgery of bank-notes.

Steel bank-note engraving, as perfected by Perkins on Warren's principle, is executed upon a plate or block of cast steel, which, to prevent the risk of warping, is of considerable thickness. The surfaces of this plate are decarbonized by placing it in a close cast-iron box, with a sufficient quantity of iron filings to cover the plate to the thickness of at least half an inch, and exposing it, while thus inclosed, to a white heat, until the steel is converted into very pure soft iron, to a depth equal to about three times the depth of the incisions to be made in executing the intended engraving. On the plate thus softened the engraving is effected with facility: and when it is completed the hardness of the surface is restored by exposing the plate for some hours to a red heat, the surface being thickly covered with animal charcoal, formed of burned leather or bones, and the whole being, as before, inclosed in a cast-iron box. The plate is afterwards cooled and retempered in a very careful manner. From this hardened plate the engraving is transferred to a softened steel roller, of small diameter, which is pressed against the plate with such force that its surface becomes embossed with a perfect transfer or impression of the engraved device. The roller or cylinder is then hardened in a similar manner to the original plate, and is afterwards made to transfer the devices from its surface to any required number of softened or decarbonized plates, which are then hardened for printing from.

The application of steel engraving to works of fine art is, in a great measure, due to the late Mr. Charles Warren. In his method the steel is softened to receive the graver, and is printed from in this softened state. But the still more modern method of steel engraving is to work upon an unsoftened plate, a process now rendered quite practicable, as the result of improvements in tools and handling. The surface of a steel plate should not be polished very highly; and in applying etching ground to it the plate should not be heated quite so much as is usual with copper. The ground should also be laid rather thicker than upon copper. As steel engravings are now usually printed from electrotype reproductions of the original plate, which are renewed as soon as they become worn, it is not considered necessary to use so hard a steel as formerly. The effects of wear are in this way completely obviated. To preserve steel plates from injury by rust it is usual to smear their surface with

bees-wax rubbed on while the plate is warm. Some use Brunswick black for the same purpose.

STEEL'BOW, in Scotch law, signifies such goods and chattels of an agricultural character (cattle, straw, corn, implements) which the landlord places in his tenant's hands to enable him to stock his farm. At the expiry of his lease he is bound to return an equal number of similar articles in equally good condition.

STEELE, SIR RICHARD, the father of English essayists, was born in Dublin in March, 1672, of a family English on the paternal side and Irish on the maternal. His father was secretary to the first Duke of Ormond, and through that nobleman's interest he was placed in the Charterhouse School of London after his father's death, in 1684.

At the Charterhouse, whose annals have been illustrated by the names of so many distinguished men down to the days of Havelock and Thackeray, commenced Steele's long and unselfish friendship with Addison, who was three years his senior in age, and many years his superior in mere worldly prudence. He gained considerable distinction by his talent and assiduity, and in 1692 went to Oxford at the head of that year's postmasters for Merton College. The classical learning which he now made his own, lent, in after years, a pleasant flavour to his writings, and it may be justly said that in an age of scholars Steele was fitted to acquire reputation by his scholarship. But a sudden ardour seized him for military reputation, and he threw aside cap and gown and enlisted in the army to fight for King William. Unable to procure a commission he entered the Duke of Ormond's troop of horse guards as a private, but it would seem that the duke exercised his influence for him, as he was speedily promoted to a cornetcy. He afterwards became secretary to Lord Cutts, the gallant fire eating colonel of the Fusiliers, and was rewarded for his services with a company in that corps.

To this patron he dedicated, in 1701, the work which first gave evidence of his literary powers, "The Christian Hero." Its success was decided, and it encouraged Steele to persevere in the new profession he had adopted. He took the town by storm, in 1702, with his comedy of "The Funeral, or Grief à la Mode," a lively and ingenious piece of writing, distinguished by close observation of character and a keen sense of the humorous. It is said to have pleased William III. so much that he inscribed the author's name in his last memorandum-book as that of a person who deserved promotion.

In 1703 Steele produced his comedy of "The Tender Husband," in which there is "some delightful farcical writing," and whose scenes are enlivened by touches from Addison's master hand. He was now appointed by the minister Harley, who was ever prompt to discern and reward literary merit, to the editorship of *The London Gazette*, and soon afterwards he was made gentleman-usher to Prince George of Denmark. In 1704 he gave to the town another comedy, "The Lying Lover," which, however, the town refused to accept—because it was too dull, said the town; because it was too moral, said its author. Its want of success prevented him from again attempting the stage until 1722.

Meanwhile Steele had married; his wife lived but a few months, and dying bequeathed to him an estate in Barbadoes. In September, 1707, he married again, selecting as his partner an amiable and accomplished woman, Miss Scurlock, of Carmarthenshire, the "Prue" of his correspondence. At this time, according to his own account, his income was £1025 per annum, an income on which most literary men would consider themselves princes, but which never sufficed for the reckless, gay, and generous Steele. To the end of his days he was never free from debt. He was always borrowing, and always promising to pay. His life was spent in alternate moods of carelessness and repentance, in jests and laughter over the wine-cup, in sad and serious reflections on the following morning. His correspondence, simple and artless as himself, supplies us with an extraordinary picture of his daily life. It enables us to trace him from his study to the tavern, from the tavern to the theatre, from the theatre to the sponging-house. His letters to his wife—there are four hundred of them—make us familiar with every feeling; we can read his heart, can trace the workings of his mind. He was always meaning well, and doing ill; always turning down the wrong road, with the best wishes in the world to go the right. His charity was boundless; he would never close his ears to the tale of distress; and a beggar could wheedle from him his last guinea, even if the benevolent prodigal knew that it was his only chance of a dinner. Steele, therefore, never made any enemies; he was everybody's "poor Dick Steele;" in many respects a counterpart of Goldsmith, and, like him, a man to be loved, admired, pitied, laughed at, respected—anything but *imitated!* Through Addison's influence he obtained the lucrative post of commissioner of stamps. But no friendship and no assistance could save him from himself, and from first to last his life was a life of anxiety and vexation.

But let us turn from these pitiful details to the brighter side of his career. On the 12th of April, 1709, appeared the first number of *The Tatler*, a series of essays on contemporary manners and customs, men and women, high life and low life, which continued to be published thrice a week—Tuesday, Thursday, and Saturday—until the end of January, 1711. As Swift had made very popular about this time the *nom de guerre* of Isaac Bickerstaff, Steele assumed it for the conductor of his new periodical; and combining news with literature he gained at once "an audience of all who had any taste of wit, while the addition of the ordinary occurrences of common journals brought in a multitude of readers." After the eightieth number Addison lent his effective aid. Swift was also a contributor. But great as these auxiliaries were Steele was a "host in himself." He wrote with the most charming ease, the most graceful humour; pulling off the disguises of cunning, vanity, and affectation; exposing the conventionalities of an artificial society; advocating truth, manliness, and honour; a strict and honest censor, but skilful in giving censure such a form that it pleased even those who were obnoxious to it. "Addison's papers," says Austin Dobson, "are faultless in their art, and in this way achieve an excellence which was beyond the reach of Steele's quicker and more impulsive nature. But for words which the heart finds when the head is seeking; for phrases glowing with the white heat of a generous emotion; for sentences which throb and tingle with manly pity or courageous indignation, we must turn to the essays of Steele."

The success of *The Tatler* induced Steele to start its more famous successor, *The Spectator*, the first number of which appeared on the 1st of March, 1710-11, and which was published daily, through 555 numbers, until the 6th of December, 1712. Its price was at first a penny; when Bolingbroke attempted to fetter the press by introducing a stamp duty it was raised to twopence. But its popularity never declined, and it paid on account of the halfpenny stamp no less than £29 per week. It had, moreover, a circulation of 10,000 in volumes.

The Spectator is unquestionably a thing *sui generis*, unique in the world's literature. Never before was folly so pleasantly satirized; never before were moral lessons adorned with such grace of fancy and elegance of style. There is a curious equality of merit in the different essays. If Addison's are the more correct, the more refined, and marked by the more consummate critical taste, Steele's are the manlier, heartier, and more vigorous. If to Addison belongs the credit of having given those touches to the portraits of Sir Roger de Coverley, Will Honeycomb, and

Sir Andrew Freeport, which fix every feature on the reader's memory, it was Steele who gave the first conception and breathed into them the breath of life.

In 1713, on the accession of Bolingbroke and a Tory ministry to power, Steele resigned his commissionership, entered Parliament as member for Stockbridge in Hampshire, and joined the ranks of the Whig opposition. In March of the same year he started *The Guardian*, which ran through 175 numbers, and in which he was assisted by Addison, Budgell, Berkeley, and other friends. Of the 271 papers in *The Tatler* Steele wrote 188, Addison forty-two, and conjointly thirty-six. Of 635 *Spectators* Addison wrote 274, Steele, 240; and of 175 *Guardians*, eighty-two were due to Steele, fifty-three proceeding from Addison's pen. We may here note that, in the course of his busy and stirring career, Steele also set on foot several other periodical essays—*The Englishman*, *The Lover*, *The Reader*, *The Plebeian*, *The Theatre;* but none of these attained a permanent position.

A pamphlet, called "The Crisis," written in support of the Hanoverian succession, excited so much animosity that in June, 1714, Steele was expelled from the House of Commons. He spoke before the bar of the House, in defence of his conduct, for three hours, prompted by Addison and supported by Walpole and Stanhope. The Tories were too powerful, however, and the motion for his expulsion was carried by 245 to 152. George I., on his accession to the throne, rewarded his advocate for his spirited exertions; he received a place in the royal household, the surveyorship of the royal stables, was made a justice of the peace for Middlesex, and on presenting an address in 1715 was knighted. He was also appointed "governor of the royal company of comedians"—a post for which we may conceive him to have been admirably fitted. Of this he was deprived in 1720, but when Walpole rose into power it was restored to him. Through the influence of the Duke of Newcastle Steele was returned to George I.'s first Parliament as member for Boroughbridge in Yorkshire, and when Addison became secretary of state he nominated him to a commissionership for forfeited estates in Scotland.

Steele's second wife died in 1718. It may have been to divert his mind that he now returned to theatrical affairs. In 1722 he produced his best comedy, "The Conscious Lovers," which proved a complete success. No strokes of happy fortune, however, could enrich the generous spendthrift, who to the last remained involved in pecuniary difficulties. To escape duns and bailiffs, as well as to retrench for the benefit of his creditors, he finally withdrew from London, and retired to an estate in Wales bequeathed to him by his second wife. Here, after a residence of about three years, forgotten by his contemporaries, and prematurely worn out, Steele died, on the 1st of September, 1729.

Steele's works have been frequently reprinted. *The Tatler* and *The Guardian* have been published in Bohn's Library, and *The Spectator* has been edited by Professor Henry Morley. Austin Dobson's "Life of Steele" (1886), in Longman's English Worthies Series, is written with all that writer's delicate insight and graceful poetic power. See also John Forster's "Historical and Biographical Essays," and Thackeray's "Lectures on the English Humorists."

STEEL'YARD, in mechanics, a balance or weighing-machine, consisting of a lever of unequal arms. The most common kind, often called the Roman balance, is a lever of the first order, and is used by suspending the article to be weighed from the end of the shorter arm, or placing it in a scale-dish from thence suspended, and sliding a determinate weight along the longer arm until the instrument remains in equilibrium in a horizontal position; the weight of the substance attached to the short arm of the lever being indicated by observing the position of the movable balance-weight with respect to a graduated scale marked upon the long arm of the steelyard. A ring or hook is attached to the fulcrum so that the instrument may be conveniently hung upon a fixed support, or if small held in the hand, and a vertical index or pointer, similar to that attached to the beam of common scales, is sometimes added. Many steelyards are supplied with a second fulcrum; the two being placed at different distances from the point to which the hook or scale is attached, and having their respective pointers and suspending hooks on opposite sides of the lever. In using a steelyard of this kind, capable of weighing from 1 to 60 lbs., the fulcrum which is nearest to the middle is employed if the article be under 15 lbs.; while if it exceed that weight the instrument must be inverted, and suspended from the fulcrum which divides the lever most unequally.

Various modifications have been contrived for delicate scientific purposes, or for weighing very heavy bodies, and one balance of this kind, capable of weighing with great nicety, where either one weight with two fulcra or two weights with one fulcrum are used, is said to be capable of indicating as little as one ten thousandth part of the weight with which it is loaded.

Several ingenious bent-lever balances have been contrived, some of which, from the circumstance of the levers being of unequal arms, resemble the steelyard in principle. These, and the steelyard weighing-machines for ascertaining the weight of loaded carriages, are noticed under WEIGHING-MACHINE.

The balance known as the Danish or Swedish steelyard differs from that above described in having the weight fixed at one extremity of the lever, while the fulcrum itself is movable.

Though probably not so ancient an invention as the equal armed balance, the steelyard is an instrument of very early origin. Under the name of *statera* it was well known to the Romans, who often used a weight in the form of a bust. Vitruvius mentions the statera, and describes the principle on which it acts. Many Roman stateræ of brass still exist, some of which are very like the steelyards of the present day. From the manner in which the steelyard is mentioned in a curious tract published in 1578, it would appear that it was not at that time much known in England.

The portable weighing-machine called the spring or pocket steelyard is noticed under SPRING-BALANCE.

The word steelyard (apparently "a yard or rod of steel") has in reality no relation to the materials of the machine, though this is often of metal. It was simply the weighing apparatus, whether made of wood or of metal, used in the famous Steelyard, the market for steel and other commodities, in Dowgate. See the next article.

STEEL'YARD, MERCHANTS OF THE, a body of aliens who enjoyed various commercial privileges in England from an early period to the middle of the sixteenth century. [See HANSEATIC LEAGUE.] They had a factory, which was called the Steelyard, or Steelhouse, situated a little east of Dowgate, between Thames Street and the river. In 1475 Edward IV. entered into a treaty with the Hanseatic League, under which treaty and their old charters the merchants of the Steelyard were enabled to monopolize certain branches of trade, in which they were exempted from duties payable by other traders; and by their combination and capital they were doubtless formidable competitors in other branches of foreign commerce.

In 1505 a rival interest was created, by a charter granted to the Company of Merchant Adventurers for trading in woollen cloth to the Netherlands; and the merchants of the Steelyard, whose monopoly had excited great discontent and caused more than one riot, were eventually, in 1551, deprived of their privileges, which were declared to be

illegal. The English Merchant Adventurers flourished on the ruin of the older corporation, which, however, continued to linger until 1597, when the Emperor Rudolph having ordered the factories of the English Merchant Adventurers in Germany to be shut up, Queen Elizabeth directed the lord mayor of London to close the house occupied by the merchants of the Steelyard. The buildings and site of the Steelyard, however, remained in possession of the towns of Hamburg, Bremen, and Lübeck, as representatives of the old Hanseatic League, till 1853, when, having no use for them, they sold the property, for which, it is said, they obtained £72,000.

STEEN, JAN, was born at Leyden in 1626, or, according to some authorities, in 1636. His father apprenticed him to Nicholas Knupfer, a German artist of considerable note, at that time residing at Utrecht. He afterwards studied under Van Goyen, who gave him his daughter Margaret in marriage. Though Steen soon acquired great reputation, he did not gain sufficient to live with comfort, because he spent much time on his pictures, and finished them with extraordinary care. He set up successively a brewery and a tavern, but failed in both attempts owing to his idle and intemperate habits. The scenes which he saw in the inn and the taproom he transferred with unrivalled skill to the canvas. None of his contemporaries surpassed him in the *naïveté* of his compositions, in the expression and character of his figures, and the skilful distribution of light and shade. He died in 1679 or 1689. Several of his finest pictures, which fetch very high prices, are to be found in English galleries.

STEEPLE, a lofty tower, is a word derived manifestly from *steep* (Old English *steáp*), which is allied to *stoop*, and expresses the idea of height, and usually of sloping height in particular. Therefore steeple is rarely the term used to express a square tower, such as rises from the midst of several of our cathedrals, but is far more often applied to a combination of a square tower and a spire, or to a spire alone. The spire springing from a square tower is a very favourite form of belfry for English churches, and may be regarded as the typical steeple.

STEER'AGE, an apartment forward of a ship's chief cabin, from which it is separated by a bulkhead or partition, or an apartment in the fore part of a ship for passengers. In steam vessels the chief cabin and steerage are separated by the space occupied by the machinery, &c.

STEE'VENS, GEORGE, the editor of Shakespeare, was born at Stepney in 1736, educated at Eton, and became a scholar of King's College, Cambridge, in 1754. His first publication was a reprint in 1766 of "Twenty of the Plays of Shakespeare, being the whole number printed in quarto during his Lifetime," &c. The reputation which he acquired from this publication led, no doubt, to his association with Johnson in the edition of Shakespeare which appeared in 1778 with their joint nar ‹ s. In this edition his assistance was of essential service. He collated all the copies diligently; restored many readings which had been tampered with by his editorial predecessors; and adhered to the old copies, without attempting to regulate the metre according to the poetical creed of his day. He afterwards dedicated himself to the production of another edition, proposing, "instead of a timid and servile adherence to ancient copies," to proceed to the "expulsion of useless and supernumerary syllables, and an occasional supply of such as might fortuitously have been omitted." The edition in which this process was perfected was produced in 1793. It is now regarded as a remarkable monument of irreverence and bad taste; but it was very popular for many years. Steevens died at Hampstead, 22nd January, 1800, and was buried at Poplar, where his memory is preserved by one of Flaxman's monuments.

STEFFA'NI, AGOSTINO, musical composer, philosopher, and statesman, was born at Castel-Franco, a small frontier town in the territory of Venice, in the year 1655. In his childhood he was a singer in St. Mark's, where a German nobleman was so much pleased with his voice and figure that he procured his discharge and took him into Bavaria. At the expense of the Elector, Steffani was instructed in all the branches of useful and ornamental literature. He learned the organ under Kerl, and soon became the recognized court "hof-musikus." In 1673 he went to Rome to make further studies in music, and now began to produce original works. He wrote with such purity and correctness that the great Padre Martini speaks with eulogy of him, and includes some extracts of his writing as examples in his famous school of counterpoint. In 1675 Steffani became court organist. In compliance with the request of his patron, who was desirous of rendering his learning of further advantage to him, he took holy orders in 1680, and was soon afterwards made an abbot. In the course of his studies he had composed several masses, motets, &c., which after his promotion were performed in the chapel at Munich. In 1681 he began the composition of opera, and achieved at once a no less decided success. The reigning Duke of Brunswick, the father of King George I., was so greatly delighted that he invited Steffani to the court of Hanover in 1688, and conferred on him the office of kapell-meister. He also committed to his care the management of the opera, an entertainment which had then but lately found its way into Germany. After his settlement in Germany, Steffani applied himself wholly to the study of secular music, and composed many operas; also a few madrigals in five parts, some of which are excellent. But the most celebrated of all his works are his duets for two voices. Of these compositions it is, perhaps, the best praise that Handel professed to imitate them in twelve duets which he composed for Queen Caroline. The musical talents of Steffani, though great, were far from being the only distinguished part of his character. His great natural endowments enabled him to act in a sphere that few of his profession ever attained. In philosophy and literature he was the friend of Leibnitz. He became a diplomatic character, and was frequently employed in negotiations to foreign courts. For his conduct in the scheme of erecting the duchy of Brunswick-Luneburg into an electorate he received from the Elector a pension of 1500 rix-dollars per annum; and by Pope Innocent XI. he was promoted to the bishopric of Spigna. Being now a statesman and a dignitary of the church, he forbore any longer to set his name to his compositions, adopting that of his secretary, Gregorio Puia; and perhaps influenced by the same motives, he in 1708 resigned his employment of kapell-meister in favour of Handel. About 1724 the Academy of Ancient Music in London elected him their president. He died at Frankfurt in the year 1730, after an indisposition of only a few days' continuance. The indebtedness of Handel to Steffani is beyond all moderation. Such fine melodies as "Angels ever bright and fair," "Let the bright Seraphim," and even important parts of the Hallelujah and other Messiah choruses are clearly taken boldly from Steffani. Like Shakespeare, Handel took his subjects as he found them, and dignified everything he took. There is a Stabat Mater by Steffani which is accounted by connoisseurs as the grandest piece of its kind immediately preceding the era of Bach and Handel, equal to anything of Scarlatti or Purcell.

STEGANOP'ODA is a group of birds belonging to the order ANSERES, distinguished by having all four toes united by a web. It contains three families, Pelecanidæ (PELICAN, GANNET, DARTER, &c.), Fregatidæ (FRIGATE BIRDS), and Phæthontidæ (TROPIC BIRDS).

STEI'BELT, DANIEL, a musician, was born at Berlin in 1755, where his father was established as a manufacturer of pianofortes. His early talents attracted the notice of Frederick of Prussia, under whose patronage his

musical studies were pursued. On the death of that monarch Steibelt quitted Berlin for Paris, where he remained some years, teaching first Marie Antoinette and then Hortense Beaumarchais; he then came to London, and continued there till 1799, about which time he returned to Germany. He shortly after travelled into Russia, and took up his residence at St. Petersburg. When the Emperor Alexander ascended the throne he appointed Steibelt his maître de chapelle in 1810, a high and lucrative office, which determined the composer to settle finally in the capital of the great northern empire, where he remained till his death in 1823. His compositions for the pianoforte are numerous, though most of them have been written with a view to extensive sale, or, in other words, having been produced from pecuniary motives, are of a light kind, had their day, and are now forgotten. But those on which he meant to build his reputation show a vigorous and original genius, as well as a command of the resources of harmony. Among these are his grand sonata for pianoforte, dedicated to Madame Bonaparte; his concertos "La Chasse," and the once all-famous "Storm;" his two sonatas (op. 80), dedicated to Prince Galitzin; his "Etudes," &c. His two ballets and five operas show talents for the stage which only wanted development. Steibelt was a melancholy example of a man of great gifts dragged down by deficient moral stamina. He was always in hot water with the publishers for some mean trick, foisting off old compositions as new by writing a few bars afresh at the beginning, or by adding a violin part to an old pianoforte piece, &c. He was also nearly always pressed for money, and yet extremely affected and arrogant. Indeed much about him would seem to indicate that he was not quite master of his actions at all times.

STEIN, HEINRICH FRIEDRICH KARL, BARON VON, an illustrious Prussian statesman, descended from a Rhenish-Franconian family of great repute, was born at Nassau, 26th October, 1757. After studying with great success at Göttingen from 1773 to 1777 he entered the Prussian civil service. Possessed of a singularly clear and discriminative intellect, of great powers of work, and an indefatigable energy, he rapidly rose in rank, and at the age of twenty-seven was intrusted with the management of the Westphalian mines. In 1786 he visited England, where he spent several months in careful study of its institutions, and derived the material for many of the administrative reforms which, at a later period, he introduced into Prussia. Passing over various preferments, we find him in 1804 the chief minister of taxation and commerce in the Prussian government. In this capacity he endeavoured to develop the internal resources of his country, to inaugurate a more liberal commercial policy, and to check the bureaucratic tendencies which have always been the vice of Prussian administration. His zeal and plain speaking were very distasteful to the court, however prized by the people, and in 1807 the king dismissed him from office. The disastrous issue of the French war, nevertheless, rendered the services of such a man indispensable to his country's welfare, and in a few months he was recalled. He immediately laboured to recuperate the national losses, and carried through a system of reforms that cut his country free from past trammels, and laid the foundations of future greatness. The land had hitherto been exclusively in the possession of the nobles; he devised a scheme by which it might be held by peasants, whilst in return the upper classes were permitted to engage in trade without losing caste. They were at the same time subjected to a fair share of taxation. All vestige of serfage was abolished. The right of self-government was given to municipalities, and military service was made compulsory on the whole male population.

Stein's patriotism, no less than his statesmanship, made him strenuously oppose the influence which Napoleon exercised over the Prussian court. The French emperor accordingly determined to get rid of so implacable and dangerous a foe, and insisted upon his dismissal. The patriotic minister was compelled to take refuge in Austria, where he afterwards became the head of a secret society, the Tugendbund, whose object was the liberation of Germany from its yoke of bondage to imperial France. In 1812 he was called to his councils by the Emperor Alexander I. of Russia, and laboured strenuously to unite the European powers against their common oppressor. In this he succeeded; and to him, more than to any other European statesman, was due the merit of forming the great coalition, which, assisted by the powerful aid of England, overthrew the conqueror's despotic sway. He was appointed president of the council of all the German states, and continued his labours until the meeting of the Congress of Vienna. From that period he may be said to have retired into private life. He was known to regard with the strongest suspicion and dislike the system which neutralized the power and resources of Germany by breaking it up into a number of petty states. His darling schemes were indeed German unity and a constitutional and free government, and though he did not live to see their fulfilment he did much to make possible that which afterwards happened. He was hated as well as dreaded by all the partisans of absolutism, whose influence at the Prussian court was for a time sufficient to baffle his able plans and cast discredit upon his patriotic advice. For the remainder of his long and honourable life he held some offices of nominal repute and distinction, but took no part in the management of public affairs. He died at Frücht on 29th of July, 1831.

The German lives of Stein by Pertz and Baur have been superseded by Professor J. R. Seeley's "Life and Times of Stein, or Germany and Prussia in the Napoleonic Age" (1879), a work of the highest importance for an understanding of the period with which it deals.

STEIN'BOK (*Antilope tragulus*) is a species of ANTELOPE, a native of South Africa. It is a graceful well-built animal, standing about 20 inches high at the shoulder. The colour is reddish-fawn generally on the upper parts, white on the lower. The horns, present only in the males, are straight, round, and slender, about 4 inches long. The head is small and pointed, with very large ears. The tail is reduced to a mere stump. The steinbok inhabits the mountainous plains and open valleys in the neighbourhood of the Cape. It is very shy, timid, and remarkably swift. It is now rather rare, from being much hunted on account of the delicacy of its flesh.

STE'LA (Gr. *stélé*, a post), in architecture, a small column or pillar, without either base or capital, generally adorned with an inscription to commemorate some noteworthy event or to honour some deceased person. Stelæ were also used as mile-stones or distance-posts.

STEL'LA MI'RA (often called simply *Mira*), the name of a wonderful star, situated in the neck of the Whale (ο Ceti, Plate CONSTELLATIONS, Southern Hemisphere, on the margin, nearly opposite the word "April"), whose light undergoes a periodical increase and diminution. It is one of those mysterious stars called *variable*. It was first observed in August, 1596, by Fabricius, when it made its appearance as a star of the first magnitude, but was entirely lost sight of before the end of the year. The same star was again seen in 1637, after which it disappeared for nine months. The following are now its general phases, which are gone through in 331 days, 8 hours. When at the greatest brightness it is equal to a star of the second magnitude, and remains so for about a fortnight. It then decreases during three months, passes entirely out of sight, continues invisible about five months, again comes into view, increases during three months, when it attains once more its maximum lustre. It does not always, however, return to the same

degree of brightness, or increase and diminish by the same gradations, or invariably remain invisible the same length of time. For the four years between October, 1672, and December, 1676, it was never seen at all, though Hevelius searched that part of the heavens diligently for it. On the other hand, it was unusually bright on 5th October, 1839, as observed by Argeländer.

STELLA'RIA is a genus of plants belonging to the order CARYOPHYLLEÆ, and the tribe Alsineæ. The characters of the genus are: sepals five, petals five, deeply-cleft, stamens ten, styles three, capsule opening by six valves, many-seeded. There are about seventy species, distributed over all the temperate and cold parts of the world. About half a dozen are found in Great Britain. In common with the whole order to which they belong, they possess no active properties. Few are thought worthy of cultivation, and when planted in gardens they require but little care. *Stellaria holostea* (greater stitchwort) is found in woods and hedges in Britain. It has long straggling quadrangular stems, narrow grass-like leaves, and large satiny white flowers, which appear from April to June. It is also called Satin-flower and Adder's-meat. *Stellaria nemorum* (wood stitchwort) is found in damp woods in the North of England and Scotland. It has a downy stem, large ovate or cordate leaves, and large white flowers. *Stellaria media* (the chickweed) is common and abundant on road-sides and waste places all over Europe. It is distinguished by a line of hairs running along the side of the stem. The leaves are ovate and mostly stalked, and the flowers are white. There are several other British species.

STELLER'IDA is a class of the subkingdom ECHINODERMATA, containing the animals popularly known as star-fishes, sand-stars, and brittle-stars. It is divided into two orders, Asteroidea (STAR-FISHES) and OPHIUROIDEA.

STEL'LIO is a genus of LIZARDS belonging to the family Agamidæ. The Common Stellio (*Stellio vulgaris*) is found in the Levant and Egypt. This lizard, the Hardun of the Arabs, is about 2 feet long, with a flat swollen body and the tail ringed with large keeled spiny scales. Its colour is olive, shaded and spotted, with black above and yellow below. It lives in desert and rocky places, and feeds on insects, in the capture of which it shows great activity. In Egypt its excrements were formerly collected and used in making cosmetics. This lizard was known to the ancients.

STEL'VIO, PASS OF (Germ. *Stilfserjoch*), a famous road in the Tyrol, in the north part of the Valtellina, leading from Bormio, on the Italian side of the Alps, to Glurns, on the Austrian side. It was opened in 1824, and finally completed in 1828; and is the loftiest carriage route in Europe, its summit being 9170 feet above the sea. This forms part of the great road between Milan and Innsbruck, and was constructed by the Austrian government at an expense of 3,000,000 florins. In the boldness of its design, the difficulties of its execution, and the grandeur of its scenery, the pass of the Stelvio is the most remarkable in Europe.

STEM, in botany, is that part of the plant which seeks the light and develops itself in the air, forming its ascending axis, and grows in an opposite direction to the root or descending axis.

The stem is at once distinguished from the root by bearing lateral organs, the leaves. [See LEAF.] Every stem originates from a bud. The primary stem develops from the *plumule* of the embryo, which is a terminal bud, growing upwards and bearing rudimentary leaves crowded on its sides. In many embryos there is a small portion of the axis situated between the plumule which forms the stem and the radicle which develops as the root; this is known as the *hypocotyledonary axis* or *tigellum*. As the stem grows the portions between the leaves usually elongate; the place whence the leaves arise is called the *node*, and the portion of the stem between two nodes the *internode*. In some plants, as the house-leek, the internodes are scarcely at all developed, so that the leaves are crowded together and form a rosette. All secondary stems arise by branching, and usually spring from buds in the axils of leaves. Adventitious shoots, however, often occur, springing irregularly from parts of the stem, sometimes from roots, as in the poplar, or from leaves, as in many ferns.

Stems are distinguished as herbaceous or woody. Annual plants send up soft herbaceous stems, which generally branch more or less, produce flowers and die down in the same year. In trees, on the other hand, the stem becomes more or less woody, even in the first year, and annually increases in thickness by the development of more wood. In many herbaceous plants, especially perennials, the stem, instead of being erect, is more or less prostrate, or even subterranean. The stem often creeps along the ground (Plate, fig. 1), giving off short adventitious roots from the nodes. It may climb along walls, &c., as in the ivy (fig. 4), attaching itself by short rootlets or fulcra. Other plants, such as the hop, bindweed, &c., grow upwards by twining round supports (fig. 5). Other climbing plants, as in the vine (fig. 3), climb by means of tendrils, which twist spirally round foreign bodies; these tendrils are sometimes lateral shoots with minute scale-like leaves, as in the vine and Virginian creeper, or parts of leaves, as the petioles in Clematis, the blades in Fumaria, and the apex of the leaves in the pea family. Stolons (fig. 2) are long slender lateral shoots which take root at some distance from the parent, and form independent plants; a good example is seen in the strawberry.

Subterranean stems are of four kinds, the bulb, the corm, the tuber, and the rhizome. The bulb is a stem remaining in the condition of a bud, with a flat disc-shaped axis bearing numerous thickened scaly leaves. A bulb is called scaly (fig. 6) when its leaves only partially overlap, as in the lily, and tunicated (fig. 7) when the leaves form complete sheaths, as in the onion. The corm (fig. 8) is a short thick fleshy stem with the internodes undeveloped. The tuber, as in the potato, is a portion of the stem developed into a thick fleshy mass with rudimentary scale-leaves, in the axils of which are buds or "eyes," from which shoots are produced. The rhizome or root-stock (figs. 9, 10) is an elongated perennial stem, usually growing horizontally underground and often thickened, and sending up leafy and flowering stems; by the presence of minute scale-leaves it is readily distinguished from a root. Good examples of rhizomes are afforded by many ferns, the Solomon's seal, anemone, couch grass, &c. Sometimes it is more or less erect, when it is called premorse (fig. 10). Perennial herbaceous plants often form a stock, which somewhat resembles a rhizome, being a tufted mass wholly or partially underground, consisting of the base of the stem covered with scale-like leaves, from the axils of which the annual shoots are sent up.

The stems of palms and tree-ferns are unbranched, as they grow only from the terminal bud. The stems of the Cacti (fig. 11) are remarkably succulent and perform the function of leaves, the latter organs being rudimentary. Some plants, as butcher's-broom (Ruscus), also bear modified branches called *phylloclades*, which resemble leaves in appearance, but bear small leaves and flowers.

The function of the stem is primarily to support the leaves and flowers, and to form the channel for the conveyance of nutrient matter from the soil. In the various kinds of subterranean stems food is usually stored up for future use.

The tissues of the stem and leaves are continuous, and the FIBRO-VASCULAR BUNDLES are in most cases common to stem and leaf. These bundles contain vessels and fibres of various kinds, and through them the sap is conveyed. See also EXOGENS and MONOCOTYLEDONS.

STEN'TOR, one of the Greeks engaged in the siege of Troy, whose voice was so mighty that it sounded like fifty men shouting at once. He was of great service, therefore, as a herald in the army. The word has become proverbial for a loud-voiced person.

STEPH'ANOS, of Byzantium, the author of a dictionary of ancient geography, is a writer whose date cannot be ascertained with certainty. It is known, however, that he lived some time between 400 and 700. The original work is, with the exception of some valuable fragments, unhappily lost, and what we now possess is only an epitome made by a Greek named Hermolaos, under Justinian II. Stephanos was a grammarian, and his main object was apparently to trace the origin of the names of countries and cities, rather than to compose a geographical dictionary. He embodied, however, in the work so many extracts from ancient authors, now irrecoverably lost, and so large a fund of historical, topographical, and antiquarian knowledge, that the loss of the original dictionary is deeply to be regretted. The epitome which we possess is itself a bulky volume, and though badly arranged, and exhibiting obvious marks of ignorance and carelessness, has considerable value for students of ancient history. The best editions are that by Westermann (Leipzig, 1839), and that by Meinecke (Berlin, 1849).

STEPHANO'TIS is a genus of plants belonging to the order ASCLEPIADEÆ, cultivated for the great beauty of the flowers. There are fourteen species, of which five are peculiar to Madagascar, five are native of tropical Asia, and four of tropical America. They are climbing shrubs with smooth coriaceous leaves and beautiful fragrant stalked umbellate flowers. The flower has a five-parted calyx and a salver-shaped corolla with a five-lobed limb. The filaments of the stamens are united into a tubular column, and prolonged into a crown of five short erect leaves. The pollen is agglutinated into pollen-masses (or pollinia), as in orchids.

STEPHEN, SAINT, the first martyr of the Christian church. He was an Hellenist by birth, and the chief of the seven (commonly called deacons) appointed to attend to the temporal affairs of the church, and especially the relief of the poor, in response to a complaint on the part of the Hellenists that their widows were neglected in the administration of the poor fund. He had before this appointment achieved a high reputation in the little community of Christianity, by whom he was recognized as a man "full of faith and of the Holy Spirit," and his elevation to office appears to have been followed by such an increase of zeal and devotion as to make him for a time the most prominent Christian in Jerusalem. His preaching, which was attended by manifestations of healing power, aroused the hostility of his former companions, the Hellenistic Jews of North Africa, Alexandria, and Asia Minor, and in a series of public disputations Stephen not only successfully defended Christianity, but developed a phase of its teaching that aroused the fanatical hatred of the Jews. Brought before the Sanhedrim on the charge of blasphemy against the Temple and the law, he faced the ferocious mob of his accusers with a courage that for a moment awed them (Acts vi. 15), and disregarding his own danger strove only to utilize his position for the proclamation of his doctrine. In his address, which is reported in Acts vii., he sought to show that, contrary to the current opinion, the presence and favour of God were in no way confined to the Holy Land or the Temple; and secondly, that the nation had always been rebellious to its highest leaders and teachers in their own generation. As he approached his application the drift of his argument became apparent to his audience, and it would seem that something in their demeanour showed him that they would not permit him to complete it, for his address suddenly changes in verse 51 to an impassioned attack, which had the effect of raising a spirit of furious rage within them. His description of his vision of "the Son of Man" in glory brought matters to a climax, and he was dragged by a yelling mob out of the Temple and outside the city and there stoned to death, commending his soul to the Lord Jesus, and praying for those engaged in his murder. Stephen takes a high place in the early history of Christianity. He was the first great Christian ecclesiastic, a circumstance recognized in the Eastern Church by his title of Archdeacon, and he was the first to gain the honour of martyrdom. Still more important is the fact that he was one of the first to penetrate the husk of Judaism which enveloped the earliest teaching of the church, and to see in Christianity a religion for the whole world. In this respect he precedes the great apostle of the Gentiles, to whom it was given to propagate and establish for ever the principles which Stephen vindicated with his life. For an account of his festival see the article STEPHEN'S DAY, ST. The alleged discovery of his relics in the beginning of the fifth century is commemorated by a festival held on the 3rd of August by the Roman Catholic Church.

STEPHEN, the official name of the following popes:—

STEPHEN I., Bishop of Rome, filled the see from 253 till 257. He had a dispute with Cyprian respecting the baptizing of heretics, of which he maintained the validity. Refusing to hold communion with the Christians in Africa and Asia Minor because of their opinion on this point, he went to an unwarrantable extreme. He suffered martyrdom in 257, and is reverenced as a saint in the Catholic Church.

STEPHEN II., became Pope in 752. Astolf, king of the Lombards, having got possession of the imperial provinces in Italy, the exarchate of Ravenna, and the Pentapolis, endeavoured to obtain possession of Rome, or at least required the inhabitants of the capital and its duchy to pay him a capitation tax as their sovereign. Under these circumstances Stephen applied for help to his patron, Pippin, king of the Franks; he went to France and crowned and anointed Pippin and his two sons. In 754 Pippin marched an army across the Alps and defeated Astolf, but in the following year the Lombard king marched on Rome, ravaged the surrounding country, and laid siege to the capital. Pippin again repaired to Italy and defeated Astolf, and compelled him to deliver up the exarchate and Pentapolis. These provinces were bestowed on St. Peter and his church. Pippin thus laid the foundation of the Pope's temporal power. Stephen II. died in 757.

STEPHEN III., Pope, was elevated to the see of Rome in 768. Constantine, a layman who had thrust himself into the papal chair after the death of Paul I., met with a barbarous punishment for his offence; and those who had supported him were treated in an equally horrible fashion by the victorious orthodox clergy. But another insurrection broke out, in quelling which Stephen was assisted by Desiderius, king of the Lombards. Towards the end of his pontificate Stephen was at variance with the King of the Lombards, who got and kept possession of part of the Ravenna exarchate. At the synod at Rome, held in 769, Stephen confirmed anew the worship of images, relics, and saints, as well as of the Virgin Mary. He died in 772.

STEPHEN IV., Pope, was elevated to the see of St Peter in 816. He went to France to crown and confer with St. Louis, and died soon after his return to Rome, in the seventh month of his pontificate, 817.

STEPHEN V., Pope, elected in 885. He had been consecrated by John, bishop of Pavia; but Charles the Fat threatened to depose him because he had not waited for his approval. The emperor, however, was appeased by Stephen's sending attestations of his being chosen according to the recognized forms. He died in 891.

STEPHEN VI., Pope, 896, became entangled in the Italian dispute then raging. In it he was under the influence of the leading Romans and Tuscans, on the side of

Guido. He caused the body of his predecessor Formosus to be disinterred, stripped of the pontifical robes, and thrown into a common grave among laymen. By the adherents of Formosus Stephen was thrown into prison, and strangled in 897.

STEPHEN VII., Pope from 928–30. Marozia and her husband Guido then ruled in Rome, and it is thought that they had put two popes to death. Stephen VII. must have been entirely under their influence. No particulars of his reign are known.

STEPHEN VIII., 939, is said to have been a relation of Otho I. Alberic, son of Marozia, ruled Rome in his day. In a popular tumult of the Romans Stephen was roughly used, and crippled for the rest of his life. He died in 942.

STEPHEN IX., Pope, 1057 (Frederick of Lorraine), was brother of Godfrey, duke of Tuscany, abbot of Monte Casino, and cardinal. Following Hildebrand's advice, he sent two legates to Milan to enforce the decrees respecting celibacy. He issued decrees against simony, enforced a more rigid discipline in his former monastery of St. Casius, exempted the clergy from the jurisdiction of civil courts and from paying tribute to laymen. It would seem that he had a plan to create a national empire in Italy by crowning his brother Godfrey king. But death prevented the carrying out of the scheme. The separation of the Greek Church from the Roman took place in his time. Stephen died at Florence in 1058.

Those who make ten popes of the name of Stephen include a certain Stephen II. the successor of Zacharias. As, however, he died three days after his election, without being consecrated, he has been omitted in the above series.

STEPHEN, King of England, born 1096, was the third son of Stephen, count of Blois, by Adela, daughter of William the Conqueror; and was consequently nephew of Henry I. of England. Henry was very fond of Stephen, who was handsome, frank, generous, and brave to excess. He attached him early to his court, and having noticed his bravery at Tenchebrai as a mere lad of ten years old, created him Earl of Mortaigne. Later on other dignities, coupled with large estates, were conferred on the king's favourite, who stood high in the graces of all men. Stephen's brother, Henry, who became Bishop of Winchester, was almost equally powerful in the state. Stephen became a feudal sovereign, and received very large additions to his English estate by a further favour of his uncle the king, who procured for him in marriage Mahout or Mathilda, daughter and heiress of Eustace, count of Boulogne (younger brother of the famous Godfrey and Baldwin, kings of Jerusalem).

On the death of Henry's only son William, in 1120, Stephen came to be regarded as the natural heir to the kingdom. Henry's daughter, the Empress Maud, was childless, and her own succession was an innovation hardly likely to be successful, for England had as yet never been ruled by a woman. Nevertheless Henry determined to make the attempt; and accordingly, in 1125, immediately after the death of the Emperor Henry V., her first husband, Henry sent for his daughter Maud to Normandy. The next year he brought her over to England, came to London, and in a council consisting of the archbishops, bishops, abbots, earls, and all the thegns, obtained, 25th December, 1126, the unanimous promise of the assembly, which included Stephen and the Earl of Gloucester (Henry's natural son), that if he should die without male issue, they would receive her as his successor. Nevertheless, as soon as Henry had expired in Normandy, 2nd December, 1135, Stephen, who, as well as Gloucester, had been in attendance on the dying king, set out for England, and landed on the coast of Kent. His position as nearest legitimate male relative of the late king had, however, now disappeared; for in 1133 Maud had borne a child named Henry (afterwards Henry II.) to her second husband, the Count of Anjou. Still it was not as yet the custom in England to allow children to succeed; and Stephen had a good case. He had already secured the support of a powerful faction of the clergy and nobility; and although refused admission by the inhabitants both at Dover and at Canterbury, was received with welcome by those of London and Winchester. Hugh Bigod, earl of Norfolk, the steward of the royal household, having boldly sworn that Henry on his deathbed had disinherited his daughter, and left the crown to his nephew, it was resolved by the clergy and nobility who had gathered about Stephen that he should be crowned forthwith. The ceremony was accordingly performed at Westminster, 26th December, by the Archbishop of Canterbury.

The bishops, however, tendered their allegiance only for so long as the king should maintain the privileges of the church; and the lay barons, among whom was the Earl of Gloucester, also qualified their oath by a similar condition as to his preservation of their estates and honours.

In January, 1136, after seeing the body of the late king interred at Reading, Stephen convened a great council of the bishops and the nobility at Oxford, and there signed a charter of the liberties of the church and state. He had shortly before obtained a bull from Pope Innocent confirming his election. Meanwhile, a feeble attempt had been made by Maud and her second husband, Geoffrey of Anjou, to take possession of Normandy; but the Normans themselves, without any assistance from Stephen, soon drove out the army of Angevins which had entered their country. In the spring of 1136 King David of Scotland, Maud's uncle, overran the northern counties, and compelled the barons of those parts to swear fealty to his niece. An insurrection in her favour also broke out in Wales; and it soon appeared that Stephen's possession of Normandy was only to be retained by force of arms. In some districts of England the empress' standard was raised by the Earl of Gloucester, and various places of strength were seized upon and garrisoned in her name. Freed from the restraint of the strong hands of Henry, the barons assumed large privileges, fortified their castles, and on all sides defied the royal authority when it conflicted with their interests. Stephen had his hands full of work with all this disorder and rebellion in the south, when the King of Scotland again appeared on the northern borders. He was, however, defeated in the famous battle of the Standard, 22nd August, 1138, near Northallerton; but peace was not concluded with the Scots till the following year.

By this time the English king had found another and more formidable enemy. He had quarrelled with the church. Resolved to reduce the inordinate power of Roger, bishop of Salisbury, and his two nephews, Alexander and Nigel, bishops of Lincoln and Ely, he had at a council held at Oxford in June, 1138, arrested Roger and Alexander; and although Nigel made his escape, he was compelled to surrender his Castle of Devizes, and his brother and his uncle yielded their fortresses at Newark, Salisbury, Sherburn, and Malmesbury. Stephen was summoned before a synod of bishops, which met at Winchester, under the king's brother, the Bishop of Winchester, who had lately been made papal legate, September, 1139. On the last day of the same month Maud landed on the coast of Suffolk, and immediately afterwards her half-brother, the Earl of Gloucester, unfurled his standard in the west. The war spread rapidly over the whole kingdom. At length, 23rd February, 1141, Stephen, while besieging the Castle of Lincoln, was attacked by the Earl of Gloucester, taken prisoner, and consigned in chains to the Castle of Bristol.

Maud was now acknowledged as queen; but the folly, rapacity, and insolence which she displayed in her triumph were soon found insupportable by all parties. Taking advantage of the strong popular feeling of disgust, Stephen's queen, Matilda, who had remained in arms for her husband

in the county of Kent, made her appearance before London. Maud fled to Oxford, and in the conflict that followed the Earl of Gloucester, having been taken prisoner, was exchanged for Stephen. When his brother was thus again at liberty, the legate, who had previously persuaded the clergy to acknowledge Maud, once more summoned a clerical synod at Westminster, 7th December, 1141, and gained them over to the cause of Stephen.

The war recommenced after Stephen had recovered from an illness which confined him for some months. From September to December, 1142, Stephen besieged Maud in Oxford; until, reduced to extremity, she desperately escaped across the snow, clad in white robes which disguised her flight. The eastern parts of the kingdom remained subject to Stephen, the western to Maud, till the death of the Earl of Gloucester, the main support of the latter, in 1146, upon which she retired to Normandy. The next two or three years of the king's reign were disturbed by a rebellion headed by Ranulph, earl of Chester, and also by another quarrel with the clergy, in consequence of which the whole kingdom was laid under an interdict. But his last and worst antagonist now appeared in the person of Maud's son, Henry Plantagenet, who, having by the death of his father, in September, 1151, become Count of Anjou, landed at Wareham, 6th January, 1153. He was met by Stephen near Wallingford, and both parties were preparing for battle when an agreement was made, which was confirmed in a great council held at Winchester in November following. By this compact Stephen, whose eldest son, Eustace, fortunately for the peace of his country, died suddenly at Canterbury during the negotiation, constituted Henry, whom he styled Duke of Normandy, "his successor in the kingdom of England, and his heir by hereditary right," Henry in the meantime acknowledging Stephen as king. Stephen survived its ratification not quite a year; he died suddenly in a convent at Dover, 25th October, 1154, and the twenty years of anarchy which he had not been strong enough to quell, ceased almost as by magic on the accession of Henry II.

Stephen is often branded as a usurper, but except in the breach of his oath to recognize the succession of Maud, he seems, on fair consideration, not blameworthy. He was certainly more in order in his claim than was Maud, going by precedents: for the kingdom, not yet accustomed to the strict hereditary principle, received its sovereigns by election. The troubles of his reign were largely due to the attempt of Henry I. to force his daughter on the nobles as their queen, a thing never before known. Stephen was able, patriotic, and diligent; and that very nobleness and sweetness of temper which gained him friends even among his opponents, and which leaves him without a single act of treachery or cruelty staining his name through all hi difficulties and dangers, was certainly a great obstacle to his success in kingship. The times needed rougher handling and greater astuteness than this true-hearted generous soldier could furnish.

Much light is thrown upon the history of this anarchical time of Stephen's reign by the nearly contemporary chronicle of William of Newbury, admirably edited and published in the Rolls Series, in 1884.

STEPHEN'S CHAPEL, ST. This celebrated chapel was built at Westminster by King Stephen, and dedicated about 1135. It was considered an admirable specimen the transition Norman period of Gothic architecture. It was rebuilt and finely embellished by Edward III., in 1347 and created a collegiate church, to which a dean and seven priests were appointed. After the suppression of the religious houses it was surrendered, in 1548, to Edward VI. and converted into a place of assembly for Parliament. It thus became the theatre of many memorable events, and echoed with the eloquence of Hampden, Ashley, Burke, Pitt, Fox, Sheridan, and Brougham. On the 16th October, 1834, it was unhappily destroyed by fire. There were few memorials of our historic past which Englishmen could not have better spared.

STEPHEN'S DAY, ST. (the 26th of December), is better known in England by its name of Boxing Day. The custom of putting money in the Christmas-box, which servants, apprentices, or the poor provided at the great festival, has become time-honoured, and is known to all. The box no longer exists, it is true—the gifts are made from hand to hand—but the custom tends to increase perhaps beyond measure, and a marked reaction is setting in which will probably reduce it to reasonable bounds before it attains the absurdly swollen dimensions of the similar New Year's gifts of the French. It is not uncommon for persons not tied to Paris to take a New Year's holiday in order to avoid the very serious tax the *étrennes* have become. The custom is of pagan origin, and the English transference of its date from New Year to Christmas is an alteration of the local church. In Scotland, when the custom is observed, the original date is kept.

But another set of observances attaches also to St. Stephen's Day. It was believed that St. Stephen protected agriculture, and especially horses, in some manner, though the matter is extremely obscure, and no trace of any connection between the first martyr of the Christian Church and the farmer's trade can be found. It is surmised that here also a pagan, or more likely a heathen ceremony, has survived, and has become attached to that saint of the Roman Catholic calendar whose day happened to coincide with its own. Thus, even now, the Finns throw silver into the horse-trough on St. Stephen's Day, while at Rome they bless the pastures. Among ourselves a custom prevailed almost universally of bleeding horses on this day with a view to prevent their catching any disorders during the year. See Tusser in his "Five Hundred Points of Good Husbandry" (1580).

> "Ere Christmas be passed let horsse be let blood,
> For manie a purpose it dooth them much good.
> The Day of St. Steeven, old fathers did use;
> If that do mislike thee, some other day chuse."

This, there is very little doubt, pointed to a sacrifice at the winter solstice among our heathen ancestors; and the custom is always attributed in our early writers to the Danes, which lends additional force to such a theory.

STEPHEN, SIR JAMES, an able essayist and historian, was the third son of James Stephen, well known for his vigorous exertions in promoting the abolition of the slave trade. He was born at Lambeth on the 3rd of January, 1789, and completed his education at Trinity Hall, Cambridge, where he earned distinction by his assiduous cultivation of the classics and jurisprudence. He took his degree of Bachelor of Laws in 1812, and was called to the bar at Lincoln's Inn in the following year. Lord Bathurst, the colonial secretary, soon afterwards appointed him solicitor to the colonial office, and he practised at the equity bar for eleven years.

Retiring from the active exercise of his profession in 1824 he accepted the office of counsel to the Board of Trade, while retaining his legal position at the colonial office. In 1834 he was appointed assistant under-secretary of the colonies, and in 1836 permanent under-secretary, a post whose responsible duties he discharged with great credit, until compelled by illness to resign in 1847. While at the colonial office he carried through two highly important tasks—the final extinction of slavery and the establishment of responsible government in Canada. These great services, however, were unknown to the general public, and his reputation first spread beyond the official world through his admirable contributions to the *Edinburgh Review*. These ranged over a period of ten years, from 1838 to 1848, and were principally devoted to subjects connected with religious biography. Their depth of thought,

clearness of judgment, and vigour of style attracted general attention, and Stephen was soon regarded as one of the principal supporters of the old "buff and blue." The most remarkable essays are those on Luther, Loyola, the Port Royal Philosophy, Baxter, and Isaac Taylor. They were published in a collective form in 1849 under the title of "Essays in Ecclesiastical Biography," and passed through several editions.

On retiring from office Mr. Stephen was made a privy councillor, and honoured with the ribbon of K.C.B. In the summer of 1849 he was appointed to the professorship of modern history at Cambridge, an office which he retained till his death, and whose duties he discharged with ever-increasing reputation; while from 1855 until 1857 he acted as professor of modern history and political economy at Haileybury College. His well-known and much-esteemed "Lectures on the History of France" were delivered at Cambridge in 1850, and published in 1852. Sir James Stephen died at Coblenz on the 14th of September, 1859. His two sons—Justice Sir James Fitzjames Stephen (born 1829) and Mr. Leslie Stephen (born 1832)—have risen to great eminence.

STEPHENS (Fr. *Etienne* or *Estienne*, Lat. *Stephanus*) is the name of a family of illustrious scholars and printers.

Henry Stephens (1) was born at Paris, probably about 1470. His earliest printed book is said to be one of the year 1502. The works which he printed were chiefly on theological, philosophical, mathematical, and medical subjects, and are noted for their remarkable accuracy and beautiful typography. He died about the year 1521 or 1522.

Francis Stephens (1) was the eldest of the three sons of Henry Stephens. He was a partner of Simon de Colines. There are very few books known to be printed by him. The earliest is a work called "Vinetum," printed in 1537. The last is the "Andria" of Terence, in 8vo. The year of his birth as well as of his death is unknown.

Robert Stephens (1), the second son of Henry Stephens (1), was born at Paris in 1503. He studied the Latin, Greek, and Hebrew languages, and was an excellent scholar. The earliest work that he printed on his own account appears to have been "Apuleii Liber de Deo Socratis" (1525, 8vo). This was followed by Cicero's "Partitiones Oratoriæ," and a great number of other works, which rapidly issued from his press. For most of these works he acted both as editor and corrector of the press. The mere list of his publications in Maittaire, from 1527 to 1560, fills twenty large octavo pages, and it is not complete. In 1531 he began the publication of his "Dictionarium, seu Latinæ Linguæ Thesaurus," the last edition of which is in two vols. folio. In 1539 Stephens was appointed printer to the King of France for Latin and Hebrew works, and shortly after for Greek works also. The first Greek book that he printed in this capacity belongs to 1540. In 1545 he published his edition of the Latin Bible, and in the next year his first Hebrew Bible. His repeated editions of the Bible and the notes to his Latin Bible, which were supposed to favour the reformed doctrines, involved him in disputes with the Sorbonne, who charged him with heresy, or at least error. But the indefatigable printer still continued his labours, and brought out among other works the *editio princeps* of the "Antiquitates Romanæ," of Dionysius of Halicarnassus. The death of King Francis I., in 1547, deprived him of a protector for his successor Henry II. was too weak and unsteady to support him against his enemies. The Sorbonne again attacked him about his Bibles, and finally succeeded in getting their sale prohibited. At last, to escape from further persecutions, this eminent scholar removed with his family to Geneva in the beginning of 1552, and there carried on his printing unmolested. He died in 1589, leaving a large family and considerable property. He published at least eleven complete editions of the Bible, in Hebrew, Greek, Latin, and French, besides many separate editions of the New Testament; and 382 other works, mostly of the first importance, came from his press. He first introduced the existing division of the New Testament into verses.

Charles Stephens appears to have been about a year younger than his brother Robert (1). He had an excellent classical education; but he also applied himself to the physical sciences, and having taken the degree of doctor of medicine practised physic for some time. He wrote several treatises on medicine, natural history, and agriculture; but he treated his subjects chiefly in relation to antiquity. In 1551, when Robert removed to Geneva, the whole of his printing establishment, with the exception perhaps of the department for printing Hebrew, passed into the hands of Charles Stephens; and the *editio princeps* of "Appian," which appeared at Paris in 1551, is probably the first book which he produced. It is a beautiful specimen of typography. Soon after Robert left Paris Charles appears to have been appointed royal printer. He died in 1564. He lost a great deal of his capital in 1557 by the publication of his "Thesaurus Ciceronianus," which was a very expensive undertaking, and did not sell. Lists of the numerous works which were written or printed by Charles Stephens are given by Maittaire and Renouard.

Henry Stephens (2) was the son of Robert (1) and grandson of Henry (1). He was born at Paris in 1528. As a child he showed most extraordinary talents. Latin he learnt early, as it was constantly spoken in the family, but before he seriously studied it his father made him learn Greek.

In 1546 he began to assist his father by collating a MS. of Dionysins of Halicarnassus, whose works he was preparing for publication. He also undertook a journey to Italy, the main object of which was to search the libraries and examine the manuscripts in that country. He returned to Paris in 1549. In 1550 he visited England, where he was well received by King Edward VI.; and on his return from England travelled the Low Countries, where, during his short stay, he learned the Spanish language.

Towards the end of 1556 he published some of the Psalms of David, translated into Latin verse: but before this year he had made a second visit to Italy. In the course of 1557 Stephens was in full possession of a printing establishment, and published seven works, among which was an edition of Æschylus. His travels and the production of expensive works seriously embarrassed him, but he was assisted by Ulric Fugger, a wealthy merchant of Augsburg, who gave or advanced to him a large sum of money. This connection, however, ceased in 1576 with the merchant refusing to advance any more.

On the death of his father at Geneva in 1559, the printing establishment then came into the hands of Henry, who appears to have given up his establishment at Paris, and thenceforward, to the time of his death, was busily engaged as a scholar and a printer. On his great work, the "Thesaurus Linguæ Græcæ," he spent ten years; and in 1572 it was published, with the appendix and index, five vols. folio. This work made an epoch in the history of Greek philology, as well as in the life of the author, who had embarked in it nearly all his property. Its price was necessarily high, and accordingly it could not have many purchasers. When Scapula, some years afterwards, published his cheap abridgment the sale was nearly stopped, and Stephens became involved in great difficulties. He died in 1598. To no scholar are students of the Greek language and literature under greater obligations than to Henry Stephens.

Anthony Stephens, son of Paul Stephens, and grandson of Henry (2), was born at Geneva in 1592. The earliest work which he printed belongs to the year 1613, and henceforth he conducted his establishment with an

activity worthy of his great ancestors until the year 1661. He was also honoured with the title of royal printer, through the influence of the Cardinal du Perron, and received a pension of 600 francs, which was stopped when his patron died. Anthony after this was several times in great pecuniary difficulties. Among his numerous publications are several valuable editions of ancient authors, such as Casaubon's edition of Strabo, 1620; of Plutarch's works, with Xylander's translation, 1624, two vols. folio; Leunclavius' edition of Xenophon, 1625; Aristotle's works, 1629, two vols. folio.

For many years after the death of the cardinal Anthony was supported by his son Henry, who, from the year 1646, had a printing office of his own, where among other works, Montaigne's "Essais" were printed. When this son died in 1661, Anthony was deprived of his only support; he became infirm, and at last lost his sight. In this state he dragged on a wretched existence until the year 1674, when he died in the Hôtel-Dieu at Paris, at the age of eighty-two. He had six children, all of whom died before him.

STEPHENSON, GEORGE, whose name is inseparably connected with the annals of steam locomotion and with the development of the English railway system, was born at Wylam, near Newcastle, in Northumberland, on the 9th of June, 1781. The circumstances of his early life were such as seemingly to preclude all hope of his ever attaining to either opulence or reputation. His father tended a colliery engine at Wylam, and on wages of twelve shillings a week endeavoured to maintain himself, his wife, and six children. He was, however, a steady and well conducted man, and he employed his scanty leisure in teaching the rudiments of knowledge to his family. George meanwhile, and almost as soon as he could walk, was made to contribute to the support of the family by herding cows at 2*d.* per day. In due time he was allowed to hoe turnips at 4*d.* per day. Seizing every opportunity of bettering himself, he next obtained an appointment as fireman at Midhill Colliery, where he worked with so much steadiness and perseverance that, at the age of seventeen, he was appointed "plugman" of a pumping engine. Thus he had actually outstripped his father, who worked at the same engine in the subordinate capacity of fireman.

He now devoted himself with unfailing ardour to the study of the engine, frequently taking it to pieces in his leisure hours that he might thoroughly master the secrets of its mechanism and properties. But as yet he was ignorant of even his letters, and he does not appear to have felt the want of book-knowledge until he found that the machines which so absorbed his thoughts were fully described in printed works—printed works that to him were as a mystery! With singular resolution he set himself to remedy his deficiency. A poor teacher in the neighbouring village of Walbottle kept a night-school, and there George Stephenson made his first acquaintance with letters, monosyllables, and pothooks. Eminently gifted with force of will, he suffered no obstacle to daunt him, and having learned to read and write, placed himself under one Mr. Andrew Robertson for instruction in arithmetic. Before the end of the winter he had mastered reduction.

Removing to Black Callerton, he continued his studies in every leisure moment, while, by mending shoes and cleaning watches, a branch of trade in which he displayed a remarkable aptitude, he contrived to save a sum of money—one guinea!—which seemed to him enormous. His superiors soon learned to recognize his intelligence and steadiness. He was promoted step by step until he reached the position of brakesman, where, with a wage of one pound weekly, he had less occasion to practise a rigid economy. At the age of twenty-one, however, he had accumulated a small capital, which enabled him to furnish a cottage and marry a prepossessing and amiable young woman, named Fanny Henderson, on 28th November, 1802. His marriage in no way affected the regularity of his daily life. He continued his studies, especially in the mechanical sciences; modelled experimental engines, and busied himself in the hopeless endeavour to discover the secret of perpetual motion. While residing at Willington, where on his marriage he had established himself, his only son, Robert, was born.

George Stephenson now removed to Killingworth, a village 7 miles north of Newcastle, where his domestic happiness was severely interrupted by the death of his beloved wife. The blow fell upon him heavily, and it was fortunate for him that at this time he received a commission to superintend the working of one of Boulton and Watt's engines near Montrose. The change did him good, mentally, morally, and physically, and after a year's absence he returned to Killingworth with £28 in his pocket. This, however, was paid to a militiaman to act as his substitute; d the pressure of taxation, high prices, and reduced wages now tried him so sorely that at one time he resolved upon emigrating to America, and was only prevented by want of funds. Still he contrived to send his son Robert to school, for he was bent upon furnishing him with a liberal education. For this purpose he worked and saved, and practised the sternest self denial, to be rewarded hereafter by his son's devotion, and gratified by his eminent ability.

Meanwhile his ingenious contrivances, for like James Watt he was born an inventor—*inventor nascitur, non fit!*—excited the wondering curiosity of his neighbours. A strange gray crow protected his fruit from the depredations of birds; cradles were rendered automatic by a clever application of the smoke-jack; alarum clocks roused his household at an appointed hour; a mysterious lamp burned under water, and attracted the fish; while his fame as an "engine-doctor" was noised over all the country side.

In 1812 he was appointed engine-wright at Killingworth Colliery, with a salary of £100 per annum. In this post he had ample opportunities for developing his mechanical skill and continuing his investigations into the value and capabilities of locomotive engines. A more economical mode of working the coal trains than by horses was much in requisition. Trevithick's steam engines were in use at several collieries, but their cumbrousness, inefficiency, and cost of fuel caused them to be regarded with little favour. After carefully examining them Stephenson declared that he could construct a far better machine. Lord Ravensworth, one of the lessees of the Killingworth Collieries, immediately authorized him to carry out his design, and after some months' labour he produced the "Blucher" engine, which was first tried on the Killingworth Railway, 25th July, 1811, and which succeeded in drawing, on an ascending gradient of 1 in 450, eight loaded carriages of 30 tons weight, at above 4 miles an hour. It was not, however, a success. After a twelvemonth's trial it was found as costly as horse-power, and probably might have been thrown aside but for Stephenson's invention and application of the steam blast, which more than doubled its power by increasing the capability of the boiler to generate steam. A second locomotive was now constructed and completed in 1815, which in all important respects must be considered the type of the present railway engine.

At this time Stephenson's name became familiar in the mouths of men through his invention of a safety lamp for the use of miners. The "Geordie" was successfully tried before the introduction of Sir Humphrey Davy's invention, to which it is still preferred in many mines.

Stephenson continued to work at the improvement of the locomotive, and of the iron rails on which it performed its journeys. His reputation daily increased, and in 1822 the Hetton Coal Company invited him to superintend the construction of a line of railway 8 miles in length. This was the first public recognition of his abilities as an

engineer. The line was opened in November, 1822, and was worked by five of his engines, each dragging a burden of 64 tons at the rate of about 4 miles an hour.

In 1823 he was appointed engineer to the new Stockton and Darlington line, at a salary of £300 per annum. It was opened for public traffic in September, 1825. The speed of its trains reached 12 miles an hour, and its success in every respect greatly exceeded the anticipations of its projectors.

The next important work in which Stephenson (now assisted by his son) was engaged is generally regarded as the inauguration of the English railway system. The construction of a railway between Liverpool and Manchester was vehemently opposed by all those "vested interests" which uniformly combine to resist the introduction of any great measure of progress. Stephenson, who was examined in its favour before the House of Commons, brought down on his head a storm of ridicule by his assertion that engines might be built to travel at the uniform rate of 12 miles an hour. "Twelve miles an hour!" exclaimed a Quarterly reviewer; "one might as well trust one's self to be fired off on a Congreve rocket!" In spite of the most unscrupulous opposition a bill authorizing the construction of the railway passed both Houses of Parliament, and Stephenson was appointed engineer at a salary of £1000 per annum—somewhat of an advance from the days when he thought himself rich with fifteen shillings per week! He immediately began to lay down the road over the shifting bog of Chat Moss, and by so doing provoked the censure of the most distinguished engineers of the day. Truckload after truckload of material was flung into the swamp, which seemed insatiable, and continually craved for more; but by a marvellous combination of ingenuity and perseverance Stephenson succeeded, and the Liverpool and Manchester Railway was publicly opened on the 15th of September, 1830. The engines were constructed by himself and his son, and accomplished a feat hitherto considered impossible. The *Rocket* attained a maximum speed of 29 miles an hour! It is unnecessary to add that the railway was a complete success, and soon became a great fact, inasmuch as it proved to be the parent of the innumerable lines which now link every part of the United Kingdom by the iron bonds of commercial prosperity and social progress.

The development of the railway system occupied the remainder of George Stephenson's life. Between 1833 and 1837 he superintended the construction of the North Midland, the York and North Midland, Manchester and Leeds, Birmingham and Derby, and Sheffield and Rotherham railways. During their progress fresh engineering difficulties continually arose, but his mind was inexhaustible in resources, and his tenacity of character never allowed him to be beaten. He was not, however, fond of "grand" works. He never created obstacles for the sake of displaying his ingenuity in triumphing over them. All his lines were laid down on the most economical principles; and from their easy gradients and general simplicity present a striking contrast to the more ambitious (and far more expensive) achievements of Brunel. His residence at this period was Alton Grange, near Ashby-de-la-Zouch, from whence he afterwards removed to Tapton House, a beautiful position near Chesterfield. His time seemed fully occupied with the details of his railway work, but his indefatigable energy contrived to take up many other industrial projects. In one day he would dictate thirty-seven letters, full of close reasoning and elaborate calculation. He frequently laboured for twelve continuous hours. He rose early, and he never wasted a minute. His body as well as his mind appeared incapable of fatigue.

The greatest of his later undertakings was the London and Birmingham (now merged in the London and North-western) Railway, in which he was ably assisted by his son. In 1840 he retired from the more active pursuit of his profession, though he still remained connected with many important lines. In 1845 he visited Belgium, in whose railway system he had been frequently consulted, and was entertained by the Belgian engineers at a magnificent banquet in Brussels. He was admitted to a private interview with King Leopold. He afterwards made an excursion into Spain to report on a projected railway. On his way home he was seized with pleurisy, and never thoroughly recovered. He spent his last days in the pleasant pursuits of a country gentleman, among his gardens and pineries, and in that close observation of nature for which all his life was remarkable. A sudden effusion of blood from the lungs, following upon an attack of intermittent fever, carried him off on the 12th of August, 1848, in the sixty-seventh year of his age.

He was buried in Trinity Church, Chesterfield, where a plain marble tablet marks his last resting-place. A statue, by the late eminent sculptor John Gibson, has been placed in St. George's Hall, Liverpool; and other memorials of him are scattered throughout the country. His life is constantly quoted as an example for youth of what may be achieved by a firm will, a clear brain, and an honest heart. And, indeed, Stephenson's moral qualities were those which will at all times deserve and generally command success. His industry, his energy, his directness of purpose, almost amounted to genius. He scorned mere sensual delights, though his mind was keenly alive to natural beauties, and the brakesman and engine-wright appreciated, like a poet, the shifting colours of the summer sky, the beauty of flowers, and the song of birds. He was the soul of honour, incapable of mean envy or small affectation; and though bred in poverty, which generally indurates the heart, he was splendidly liberal, and modest merit invariably found in him a generous protector.

A full and elaborate biography of this justly distinguished man forms the third volume of Mr. Smiles' "Lives of the Engineers." The same popular writer has also published, in one compact volume, the "Story of the Life of George Stephenson."

STEPHENSON, ROBERT, only son of the preceding, was born at Killingworth, near Newcastle, on the 16th of October, 1803. His father at this time was in obscure circumstances, but sensible of his own deficiencies, and keenly alive to the advantages of a liberal education, he gladly submitted to any sacrifice in order to provide his son with the weapon he himself was in need of. "In the earlier period of my career," he said long afterwards, "when Robert was a little boy, I saw how deficient I was in education; and I made up my mind that he should not labour under the same defect, but that I would put him to school and give him a liberal training. I was, however, a poor man, and how do you think I managed? I betook myself to mending my neighbours' clocks and watches at night, after my daily labour was done; and thus I procured the means of educating my son!" His son fully repaid him for the self-denial. He displayed intellectual powers of no ordinary character, combined with the most resolute industry and the firmest purpose. His father's improved circumstances enabled him, in 1820, to spend a session at the University of Edinburgh, where he was remarkable for the success of his mathematical studies. He returned home to become the right arm of his father in his railway labours and engineering projects, furnishing that culture of intellect and fulness of scientific knowledge which George Stephenson did not possess. In 1823 he co-operated in the survey for the Stockton and Darlington Railway. In the following year an important engineering appointment called him to South America, but he returned to England in 1827, after a visit to the United States and Canada. He then assumed the management of the locomotive factory at Newcastle, and introduced many valuable improvements

into his father's engines. He afterwards assisted the elder Stephenson in the construction of the great lines of railway committed to his charge; and most of the works on the London and Birmingham line were designed and executed by him. Their admirable execution raised his reputation as an engineer to the highest point; and scarcely a scheme of any importance was afterwards projected in which he was not consulted. His undertakings surpassed his father's in brilliancy, while equalling them in simplicity and thoroughness. In proof it is only necessary to refer to the Britannia Tubular Bridge (1850), a remarkable monument of his genius and perseverance; the Victoria Bridge across the St. Lawrence (1860), a yet more remarkable achievement, which still remains unsurpassed; the bridges across the Nile at Damietta; the high-level bridge across the Tyne at Newcastle (1849); the splendid viaduct, or Royal Border Bridge, across the Tweed valley at Berwick; and the Conway Tubular Bridge over the Menai. The design of the tubular bridges was originated by the condition which the Admiralty imposed on the Chester and Holyhead Railway Company in 1844—namely, that a clear headway of 100 feet at high water should be left across the whole breadth of the Menai Straits. For this purpose Stephenson devised the principle of a plate-iron tubular girder, through the interior of which the trains should run. The Conway Bridge, erected on this plan in 1848, may be regarded as a tentative attempt. The Britannia has four spans in all, two of 460 feet each, and two of 230 feet. The Victoria consists of twenty-five spans, the central 330 feet, and each of the others 242 feet.

In 1829 Robert Stephenson married Frances, daughter of John Sanderson, a London merchant. She died in 1842 without issue. In 1847 he was returned to the House of Commons as member for Whitby. From 1854 to 1856 he held the post of president of the Institution of Civil Engineers. In 1855 the Emperor of the French acknowledged his splendid engineering abilities with the decoration of the Legion of Honour, while the University of Oxford nominated him a D.C.L. Long-continued labour of the most exhaustive kind now began to tell upon his frame. He endeavoured to obtain rest and relaxation in his favourite pursuit of yachting; but he had strung the bow too tightly, and while in Norway, in 1859, he was seized with a sudden and brief illness, which terminated his spotless career on the 12th of October. The whole nation deplored his premature death, and he was honoured with interment in Westminster Abbey. His fame will long survive as that of one of the ablest, most successful, and, let us add, most generous of English engineers.

STEPPED GABLES are those where the outline of the gable is formed, not by two sloping lines, but by a series of steps. Frequent examples occur in Scottish architecture; the stepped gable, a favourite feature of Renaissance architecture, being brought to Scotland during the period of the French influence at the close of the middle ages. See the illustration from the beautiful Falkland Palace, in the article SCOTLAND, section *Scottish Architecture*.

STEP'PES, a Russian name given to the extensive plains which lie on the north-west of Asia, occupy the low lands of Siberia, and stretch from the Dnieper across the south-east of European Russia. The word strictly denotes a flat, open, and unwooded country, mantled with a rank, grassy, and herbaceous vegetation. This is the general character of the steppes, but they also include extensive swamps and marshes, with tracts of saline sand of the true desert description, and small coppices in a few favoured spots, which shelter game. The surface is undulating, marvellously changing its aspect with successive seasons of the year. Yet the uniformity soon becomes wearisome at every period, whether the ground is mantled with snow as in winter, green with herbage and variegated flowers as in spring, or appears a perfect desert of dust and ashes, arising from the baked and pulverized vegetation in the heat of summer. But the change from day to night in the steppes always produces a great effect on the stranger. It occurs with a suddenness which is very impressive, and at first somewhat awful. Earth and sky are in a blaze of light till the sunset actually commences. In a few minutes the whole orb is below the line of the steppe, and the bright glow is gone from the landscape. In spring the vegetation of these districts is astonishingly luxuriant, but not remarkable for variety. The most common plants are hairgrass, feathergrass, thistles, wormwood, and larkspur. In winter the appearance of the steppes is dreary in the extreme, every trace of a road or trackway being obliterated by the snow, and storms of fearful violence are frequent. Here and there are tracts which offer some inducement to the agriculturist, such as the district east of the Dnieper, that between the Don and the Volga, and the plains of South-western Siberia. In the Altai mountains mining is carried on. The wandering tribes in the steppes are very numerous, and are continually shifting their ground to find food for their numerous cattle, consisting of horses, camels, horned beasts, sheep, and goats. The extent of the steppes is estimated at more than a million square miles. See PLAINS.

STERCU'LIA is a genus of plants which gives its name to the order STERCULIACEÆ and tribe Sterculieæ. The species, between fifty and sixty in number, consist of various-sized trees with soft timber, which are found in the tropical parts of the world, chiefly Asia, with simple or compound leaves and axillary panicles or racemes of flowers. The flowers are generally unisexual, and have a coloured bell-shaped calyx, no petals, and fifteen or ten antlers borne on the top of the staminal tube. Many of them are of considerable use in the countries where they are indigenous. Like the family to which they belong, several species are mucilaginous; and others yield fibre, which, from its tenacity, is made into ropes. The bark is strongly astringent. The seeds are oily and slightly acrid, and are used for seasoning food, their outer fleshy envelope being eaten. Some species yield a gummy exudation resembling tragacanth, for which it is sometimes substituted. Thus the gum called tragacanth, which is sometimes imported from Sierra Leone, is obtained from *Sterculia tragacantha*. *Sterculia guttata* yields a bark from which the natives of Malabar prepare flax-like fibres, which are woven into a sort of cloth. From the bark of *Sterculia villosa*, a native of India, very strong pliable ropes are made, which are used by elephant-hunters. *Sterculia carthaginensis*, a native of tropical America, has seeds about the size of a pigeon's egg, which are eaten as nuts in Brazil and Panama.

STERCULIA'CEÆ is an order of plants belonging to the group POLYPETALÆ. There are over 500 species, distributed in the tropical and subtropical regions. They are trees or shrubs, sometimes climbing herbs, with the branches covered with starred or forked hairs, often mixed with simple hairs. The leaves are alternate, entire, toothed or lobed, furnished with free stipules. The flowers are axillary, rarely terminal, regular, hermaphrodite, or unisexual. The calyx is usually persistent, five to three cleft, with valvate lobes. The petals are either altogether wanting or are five, hypogynous, free or adnate by their base to the staminal tube. The stamens vary greatly in character. The filaments are often connate into a tubular or urceolate column, with the top of the tube divided into five teeth (staminodes) alternate with the petals, and between them a solitary anther, or from two to five or a greater number; or the anthers may be inserted on the column from the middle to the top, or be adnate to the top of it; sometimes there are five fertile stamens, free or nearly so, opposite to the petals. The anthers are two-celled. The ovary is free, four to five celled, with the carpels sometimes distinct; there are two ovules in each cell. The fruit is dry or (rarely) fleshy.

Sterculiaceæ abound in mucilage, and the bark of the woody species contains an astringent principle; they possess stimulating and emetic properties. From the seeds of *Theobroma Cacao* are procured chocolate and cocoa.

The order is divided by Bentham and Hooker into seven tribes—Sterculieæ, Helictereæ, Eriolæneæ, Dombeyeæ, Hermannieæ, Buttnerieæ, and Lasiopetalæ.

STÈRE (Gr. *stereos*, solid) is the name of the cubic unit in the French metrical system. It is a cubical metre, and equal to 1·3080215187 English cubic yard. A *decastère* is 10 stères, and a *decistère* the tenth part of a stère.

STEREOCH'ROMY, or Solid Colouring, a process of fresco-painting, invented by Fuchs, of Munich, which has the merit of durability, from being covered by a varnish to protect it from the atmosphere.

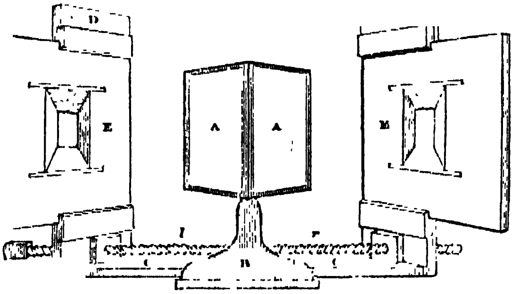
STER'EOGRAPH'IC (Gr. *stereos*, solid, and *graphein*, to draw), a term which, though it ought to be applied to every method of representing a solid in a plane, has yet a limited technical sense, being appropriated to that projection of a sphere in which the eye is at a point in the sphere, while the plane of projection is the great circle, of which the eye is at the pole, or a plane parallel to it. This mode of projection was known to Hipparchos, and was first described in the work on the planisphere attributed to Ptolemy.

The stereographic projection has two remarkable properties. The first is, that all circles are projected either into straight lines or circles. Those which pass through the eye are of course projected into straight lines; in every other case the projection is the sub-contrary section of a cone, which has its vertex at the eye, and the circle to be projected for its base; consequently the projection is a circle. As much of the circle as lies below the plane of projection (the eye being considered as above it) is projected inside the great circle on which the projection is made, and all the rest outside; when this projection is employed in maps, it is usual to place all the part of the globe to be projected below the plane of projection.

The second property is, that the angle made by two circles which meet on the globe, is equal to the angle made at the point of meeting by the two circles which are the projections of those circles; the angle made by two intersecting circles on the globe being always that made by their tangents.

STER'EOSCOPE (Gr. *stereos*, solid, and *skopeō*, I view), an optical instrument for whose invention we are indebted to Professor Wheatstone. It had been a problem to that gentleman, what would be the visual effect of simultaneously presenting to each eye, instead of the object itself, its projection on a plane surface as it appears to the eye? And it was to solve the difficulty, to bring the question to experimental test, that the professor constructed the instrument since named the Stereoscope.

It was manifest, when once the attention of scientific observers had been called to the fact, that since the two eyes look at any object from different positions each must see a different image. For instance, the right eye may see only the front of a cube, while the left eye can see a little of the left side of the cube also. Wheatstone published this simple observation in the *Philosophical Transactions* for 1838, and based upon it the true theory of stereoscopy, *i.e.* solid vision. Repeated experiments have since shown that if we are able to present two suitably differentiated pictures to the two eyes separately, no matter how this is accomplished, the brain is cheated by the usual conditions of solid vision having been fulfilled, and the pictures at once melt together into one apparently solid image. Wheatstone's first instrument was upon a reflecting system. It consisted of two plane mirrors, A A, so adjusted as to form an angle of 90 degrees with each other. They are fixed by their common edge against an upright, B, in such a way as to reflect the images placed in the side-frames, E E, fixed on the upright boards, D D. The latter are attached to the sliding-boards, C C, movable from either end by the

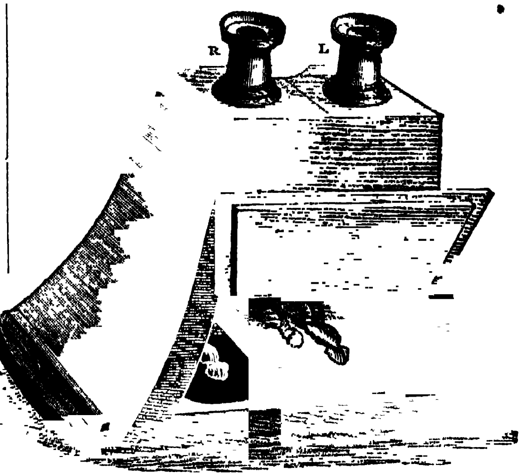


Wheatstone's Reflecting Stereoscope.

wooden screw, *l r*, formed with a right and left hand thread for that purpose. The picture showing more of the right side of the object is placed at *r* (though this is to the left of the observer), and that showing more of the left side at *l*, because of the lateral inversion of the reflected images.

The manner of working the instrument is as follows:—After the pictures have been attached to the slides, the observer must approach with his nose immediately in front of the vertical angle made by the reflectors; so that the right eye is directly before the right-hand mirror and the left eye before the left-hand mirror, and the view by each eye will then be limited to the rays reflected by its proper mirror. The pictures will be viewed, so to speak, behind the mirror; and slightly converging the eyes, either by an effort of the will or by moving the slides some distance forward, the observer has before him not merely pictorial resemblances, but seemingly the very objects themselves.

In the early stages of invention, however, the outlines of geometrically solid figures could alone be obtained; but even these, when depicted by skilful artists according to



Brewster's Stereoscope.

the requirements of the stereoscope, received unbounded admiration. In 1849 Sir David Brewster originated that convenient form of instrument now generally in use. For this, the pictures are mounted side by side on cardboard, and are viewed by the means of semi-lenses, separated by the distance of the two eyes.

The principle relied on by Sir David Brewster is this:—If an object be viewed through a lens in the most con-

venient manner, it will be found that the lens is held so that the eye looks directly through the centre of the lens at the object viewed. If now the lens be shifted to the left the object appears to shift to the right, and *vice versâ.* Sir David Brewster therefore cut a lens in half, and put the right-hand half on the left side, the left-hand half on the right side—or, in other words, the two somewhat wedge-shaped pieces of glass which the half-lenses produced were placed with their thin edges together; and therefore when the eyes looked at the two pictures through the half lenses so arranged, each eye referred its own picture more towards the centre of the instrument than its true position was. Consequently the mental images of the two pictures overlapped, and the conditions of solid vision were amply fulfilled without fatigue and in the simplest manner, in addition to which the pictures were slightly magnified, to the great improvement of the result.

Among minor applications of the stereoscope, we may mention the Stereomonoscope of Mr. Claudet, and the Stereotrope of Mr. Shaw. In the former two pictures of a stereoscopic pair are placed, by means of lenses, on the surface of a piece of ground glass, in such a manner that they both occupy an equal and similar place, and the observer, looking from the opposite side of the glass, and expecting to find a confused conglomeration of two pictures, is agreeably disappointed in a single stereoscopic representation, possessing the usual attributes of solidity or relief. In the latter we discover the principle of the stereoscope applied to that class of instruments dependent for results on "persistence" of vision—"thaumatropes," &c. A paper was read before the British Association, in 1868, on the Real Image Stereoscope, with illustrations of solid geometrical figures. In ordinary stereoscopes the observer places his two eyes opposite two lenses, and sees the virtual images of two pictures apparently at the same time. In the real image stereoscope the observer stands about 2 feet from the instrument, and looks at a frame containing a single large lens. He then sees, just in front of the lens, a real and inverted image of each of the two pictures, the union of which forms the appearance of a solid figure in the air between himself and the apparatus.

But perhaps the stereoscopic principle is most strikingly illustrated in the binocular microscope of Mr. Wenham. In this, the right and left eye pictures respectively are thus obtained:—Behind the object glass a small and peculiarly shaped prism is so placed that it intercepts the whole of the rays from the right half of the lens. After they have been twice reflected within the body of the prism, these rays finally emerge at such an angle from their original direction that they cross the undiverted pencil of rays transmitted by the other half of the lens, and are then received into another tube. And this, inclined at a proper angle to the first tube, conveys them to the left eye; whilst the other complement of rays pursues its course to the right eye.

STEREOTYPING (Gr. *stereos*, firm or fixed, and *tupos*, a figure or type), the process of producing casts or plates in type-metal from pages of movable type, from which impressions may be obtained as in ordinary letterpress printing. The plate is about three-sixteenths of an inch in thickness, and when in use is temporarily mounted upon blocks of wood or metal, on which it is held by small metallic strips called *catches*, fastened on the edges of the block, the plate and block together being the height of ordinary movable type. The principal value of stereotyping is the advantage it affords of cheap reproduction, and of duplicating formes, so as to produce large impressions rapidly. For a work of limited and temporary circulation it is unnecessary, but where the demand is great, and likely to be renewed, it is all-important, as it enables the publisher to keep up the supply at a comparatively small outlay, and without loss of time.

The origin of this valuable invention is involved in considerable obscurity. By some authorities it has been ascribed to a Dutch printer, Van der Mey, who, early in the eighteenth century, printed several editions of the Bible from formes of fixed type. His process, however, was not stereotyping; it simply consisted in soldering together the bottoms of the pages, so as to render them solid, and was intended to prevent any possibility of errors occurring through letters falling out. William Ged, a goldsmith of Edinburgh, was probably the true inventor of the art, as he was certainly the first to apply it. In 1725 he first began his experiments, and succeeded in organizing a company, by whom, about 1731, several Bibles and other works were stereotyped for the University of Cambridge. From various causes, however, the university abandoned the use of the plates; and Ged returned to Edinburgh, where, after producing several other works, he died in reduced circumstances in 1749, and his invention fell into disuse.

About the year 1780 Mr. Tilloch, editor of the *Philosophical Magazine*, also conceived the possibility of casting whole pages, though he was at that time unacquainted with the prior experiments of Ged. He communicated his idea to Foulis, printer to the University of Glasgow, and they jointly produced several works, some of which were circulated without any intimation of the process by which they were printed. Satisfactory as they were, they did not immediately lead to the adoption of stereotype printing.

The revival and introduction into common use of the stereotyping process is in a great measure due to the later exertions of Earl Stanhope, who assisted with his counsel and purse many of those who were then engaged on the subject; and stereotype printing became firmly established about 1809.

As now prosecuted, there are two modes of stereotyping, respectively known as the plaster of Paris or stucco process, and the papier-mâché or paper process. The development of the latter has been of especial service in the printing art; the duplication of large newspaper formes by its aid having effected an increase in the rapid printing of newspapers almost equal to that originally caused by the introduction of steam-power machinery.

Plaster of Paris Process.—In this process the types are set up and formed into pages in the usual manner, with the illustrative woodcuts, if any. Each page, if large, or every two or four, if small, is separately locked up in a small frame or chase, surrounded by fillets of wood or metal, which serve in the cast to form a border or bevel for attaching the plate to the mount. The face of the types is then brushed over with oil, to prevent the mould from adhering to them. An iron frame, rather larger than the page, is laid upon the chase, in order to retain the stucco while in a fluid state, and to regulate the thickness of the mould. The stucco is then poured upon the types, and soon sets into a solid mass, which must be lifted off with great care, and trimmed at the edges. The stucco mould must now be baked in an oven, heated to about 400° Fahr., until thoroughly hard and dry. It is next placed in a cast-iron box, rather larger than itself, which is covered in by a lid, having its corners cut off to allow the melted metal to enter it. The box, previously heated to the same temperature as the mould, is then plunged into a large pot of melted type metal for about ten minutes, when it is gently raised and placed on an iron table to cool; after which the contents of the box are removed in a mass, and the stucco mould is broken away from the cast, the face of which presents a fac-simile of the types and woodcuts from which the mould was taken.

The plate is next transferred to the finisher or picker to be carefully examined, and to remove any imperfections in the casting. The plates, although cast of as equal a thickness as possible, require to be accurately flattened on

the back before being printed from; and they are therefore either turned in a lathe, or planed with a machine. Defective letters or words which cannot be corrected by the picker should be cut away, and types inserted in their place; and all blank spaces which are liable to soil in printing cut down.

Paper Process. - This method of stereotyping, which is of more recent introduction, was first practised in Paris. On the face of the type, which is first slightly oiled on the surface, is laid a matrix, consisting of several sheets of fine but tough tissue paper, pasted together and damped, the outer sheet being of a stout bibulous texture. This is equably struck with a large flat brush till it has received an impression of the type beneath. The indentations made by the type are represented by elevations on the outside of the matrix, and the interstices by corresponding hollows, which are at this stage carefully filled up with a thin coating of stucco until the back is rendered quite level, when another sheet of paper is pasted over it. The forme of type, with the mould upon it, is then placed upon a hot surface or steam-chest, and covered with a blanket to absorb the moisture; over all an iron plate is screwed down moderately tight, to prevent the matrix from warping. When sufficiently dry the matrix, now become the mould, is easily removed, and is ready for casting. This is effected in an ingeniously contrived box, with a hinged lid, but without sides; the thickness of the plates being regulated by an adjustable gauge, laid upon the sides of the mould. After the lid has been firmly screwed down upon the gauge, the operation is completed by pouring in the requisite quantity of metal, which sets in a few seconds. On opening up the box the mould is easily detached from the face of the plate, which is then transferred to the picker to be finished. The mould, being still fit for use, may be preserved, either for reproducing other casts immediately or for future service. This process is of great utility in the case of cheap publications, or works of which reprints are frequently required, as the moulds are light, and involve little expense either in formation or storage.

Newspaper Stereotyping.—The application of stereotyping to duplicating newspaper formes was first adopted in connection with the *Times*, where it has now been brought to a high state of perfection. The experiments were first made in 1856 by Mr. Walter, the proprietor of that paper, and an Italian founder named Dellagana, when from paper moulds single columns were stereotyped and planed and finished with sufficient speed to get up the duplicate of a forme of four pages, which were worked on a separate machine. By this means the printing of the *Times* was accelerated by nearly 5000 impressions per hour. Improvements followed by which the separate columns were adapted to the Applegath machine then in use, raising the increase to 10,000 impressions per hour. The value of the process being thus proved, on the introduction of the Hoe machines the casting of single columns was abandoned, and a mould of the entire page, beat in with brushes in the usual manner, was taken at one operation. Rapidly dried on heated surfaces, the mould was accurately adjusted in a curved casting-box, exactly corresponding in shape to the cylindrical drum of the machine, and arranged so as to secure the casting being of as regular and uniform a thickness as possible. A curved plate was thus obtained, which was finished on specially constructed machines, one for squaring the edges and the other for planing it. The finished plate could be laid on the machine, and set to work within twenty-five minutes from the time at which the operations were commenced.

By a still more recent improvement in moulding, originating in the same office, the beating-in of the matrix with brushes is dispensed with. The forme, with the matrix laid upon it, is placed in a roller press, where a roller passes under the forme, and presses it up against the paper, so that it receives the impression of the type. By this method a much more uniform face is given to the mould than can be otherwise obtained, and with far less injury to the face of the type. The casting is afterwards effected in the manner already described. To such perfection has this system been carried, that the finished plates can be produced in seven minutes, the impression obtained from them being almost equal to that from movable type. The plates, after performing their work for one day, are melted down for the next day's issue.

A very great saving is effected by this process in the tear and wear of types from the rapid and destructive friction of the machinery, and other causes. When printed from movable type, it was necessary to renew the founts used in the *Times* every few months; since the introduction of the improved stereotyping the same fount has been in use for nearly seven years.

Nearly all the principal London and provincial newspapers are now stereotyped every morning in this manner. The formes of type are seldom used to print from; a number of plates being produced corresponding to the number of machines employed, and the entire impression printed from them, leaving the type formes ready for any exigency. It is thus obvious that, by the multiplication of machines and stereotyped plates, there is practically no limit to the number of impressions which could be obtained in the time generally allowed for their production; so that stereotyping, as now perfected, may be numbered among the most important adjuncts of the newspaper press.

STER'LET (*Acipenser ruthenus*) is a species of STURGEON (Acipenser), inhabiting the Caspian and Black Seas and the rivers which flow into them. The sterlet is a small species, from 2 to 3 feet long. The body is covered on the back and sides with rows of bony plates, and the snout is elongated, narrow, and pointed. The general colour is dark gray, with the plates whitish and the belly silvery. In the Volga and other rivers the sterlet spawns early in May in water of the temperature of 54° Fahr., and the eggs are sometimes fertilized artifically. The embryos are hatched in about seven days, and at first are about a quarter of an inch in length; in ten weeks they grow to a length of 2 inches, feeding on the larvæ of insects. Both eggs and young are often transported overland to stock other rivers, and in this way the species has been introduced into Sweden. The sterlet is highly esteemed as food, and furnishes the very best isinglass.

STER'LING, a word applied to all lawful money of Great Britain. Its origin and derivation are by the best philologists attributed to an abbreviation of *Esterlings*, or *Easterlings*, *i.e.* the Hanse merchants of the north-east of Europe, who were employed in regulating the coinage of England and conducting much of the foreign trade. In fact this is an actual statement of Walter de Pinchbeck, a monk of Bury in the time of Edward I. "*Sterlingi* a nominibus Easterlingorum nomina sua contraxerant, qui hujusmodi monetam in Angliæ primitus componebant." Their charter dated from Henry III., who in 1529 extended to them a determined protection, partly at the request of his brother Richard, earl of Cornwall, titular Emperor of Germany. The word "sterling" was in Henry III.'s time synonymous with "penny," the ancient national coin. Thus we read as a definition of a "mark" in a charter of that king, that it shall consist of thirteen shillings and four sterlings, *i.e.* 13*s.* 4*d.* Later on the word was used for all *good* coin. It now serves figuratively to express any unusual purity of manufacture or composition, and even extends to character and mental attributes.

STER'LING, JOHN, a poet and novelist of unusual promise, was born at Kaimes Castle, in the Isle of Bute, on the 20th of July, 1806. He was descended from an ancient Scottish family which had long been settled in Ireland. His father, Captain Edward Sterling, was the

chief writer in the *Times* newspaper, known, from the energy of his style, as "The Thunderer." He studied for a year at the University of Glasgow, and completed his education at Cambridge, where his remarkable powers secured him a widespread reputation and the friendship of many distinguished men. He left Cambridge in 1827. In 1830 he married, and dangerous symptoms of pulmonary disease manifesting themselves, removed with his wife to the island of St. Vincent to superintend some family property. But he could not long endure his expatriation. He returned to England in 1834, and entered the Anglican Church. For eight months he acted as curate to Archdeacon Hare at Hurstmonceux, in Sussex; but his restless inquiring mind unsuited him for such a position, and feeling mentally unfit for the exercise of sacred duties, he abandoned the clerical profession and entered upon a literary career. To *Blackwood's Magazine* he contributed some brilliant papers, and he also wrote "Arthur Coningsby," a novel; "Strafford," a tragedy; Poems; and "The Election," a satire. His increasing ill-health, however, prevented him from maturing any complete work, and his writings are chiefly valuable for their evidences of an active, inquiring, and imaginative mind resolutely bent upon grappling with the great problems of human life, and ardent in its aspirations for a purer and more perfect state of being. Sterling died at Ventnor, in the Isle of Wight, 15th September, 1844. His death had been immediately preceded by the decease of his mother and his beloved wife.

It is no small testimony to his genuine worth and the promise of his genius, that both Archdeacon Hare and Carlyle should have written his life. The archdeacon's biography appeared in 1845, prefixed to Sterling's "Miscellaneous Works" (in two volumes). Carlyle's eloquent and impassioned tribute to his memory was published in 1851. He thus describes his dead friend:—"He was good, and generous, and true; joyful where there was joy, patient and silent where endurance was required of him; shook innumerable sorrows and thick-crowding forms of pain gallantly away from him; faced frankly forward, and with scrupulous care to tread on no one's toes. True above all, one may call him; a man of perfect veracity in thought, word, and deed. Integrity towards all men—nay, integrity had ripened with him into chivalrous generosity; there was no guile or baseness anywhere found in him. Transparent as crystal; he could not hide anything sinister, if such there had been to hide. A more perfectly transparent soul I have never known." Higher praise, we think, it is difficult to bestow on any man.

STERNAR'CHUS. See GYMNOTIDÆ.

STERNBER'GIA (after Count Sternberg) is the name originally applied to a plant-fossil from the coal measures. The long cylindrical fossil is marked by a number of regular transverse lines, placed close together, and its true nature was for a long time very doubtful. Professor W. C. Williamson has shown that it is really the cast of the pith cavity of a coniferous tree, called Dadoxylon, and that the remarkable ornamentation is due to the presence of a series of thin septa of pith, dividing up the cavity in the original plant.

STERNE, LAURENCE, one of the most fertile if not the most original of English humorists, was the great-grandson of Roger Sterne, archbishop of York (died 1683), but the prelate transmitted nothing of his sententious gravity to his descendant. His father, Roger, was a veteran soldier, who served in Flanders under the great Duke of Marlborough, and married there in 1711 the widow of a captain and stepdaughter of a noted sutler, to whom he was considerably in debt. He was a lieutenant in Handaside's regiment, and at Clonmel in Ireland, on the 26th of November, 1713, the day after his arrival there with his regiment, a son was born to him, whom he named Laurence. The early years of Laurence Sterne were therefore spent in the barracks and the barrack-yard, as his father's corps moved from one Irish station to another. It was a strange kind of experience for a clever boy, but furnished him with suggestions, which, at a later period, he turned to fruitful result. His father, who died in Jamaica in 1731, supplied the original of Uncle Toby. During this novitiate Sterne also picked up those hints of military life in Flanders which he so happily embodied in "Tristram Shandy," and probably met with the character, or characters, whose idiosyncrasies found "a local habitation and a name" in Corporal Trim. At the age of ten young Sterne was placed at a boarding-school near Halifax, where he remained for about eight years. In 1733 he was entered at Jesus College, Cambridge, where he took his B.A. degree in 1736, and that of M.A. in 1740. Gray was then a pensioner of Peterhouse, but the poet and the humorist never met.

Sterne was educated for the church, and on quitting the university was appointed through his uncle's interest to the vicarage of Sutton, whose duties he undertook in August, 1738. In 1741, after a courtship of ten years, he married a lady with some little fortune and many excellent qualities. His wife's relations soon afterwards procured him the living of Stillington, near that of Sutton, and through his uncle he was made prebendary of York. Provided with a sufficient competency, for twenty years Sterne discharged his clerical duties with commendable fidelity; "books, painting, fiddling, and shooting being his only amusements." He was unconscious, in all probability, of the extent and true direction of his own genius, but the success of "Tristram Shandy," published in 1759, must have revealed it to him. He woke up one morning, to use a well-known phrase, and found himself famous. On visiting London he was lionized everywhere, fêted, caressed, eulogized; nothing was talked of but "Tristram Shandy;" Corporal Trim and Uncle Toby were universal favourites. For the first two volumes he received £700, and was promised a similar sum for the third and fourth. He was also rewarded by Lord Falconbridge with the curacy of Coxwold in Yorkshire—"a sweet retirement," he says, "in comparison of Sutton."

In 1760–61 he took a house at York for his wife and daughter, and repaired to London with the two new volumes of "Tristram Shandy." He also produced a couple of volumes of "Sermons," which were scarcely less popular than his Rabelaisian fiction. He was now received into the élite of fashionable society, where his conversational powers and gay sparkling persiflage eminently fitted him to shine. His popularity neither improved his morals nor his heart; and though a recent writer has attempted an able defence of him, it is impossible to deny that his conduct was unworthy of his sacred office, and that the sentimental, gushingly pathetic Demokritos of modern society was guilty of mean, selfish, and unmanly actions. Garrick said of him, truly enough, "he degenerated in London, like an ill-transplanted shrub; the incense of the great spoiled his head and their ragouts his stomach. He grew sickly and proud, an invalid in body and mind."

The third and fourth volumes of "Tristram" appeared in 1761, the fifth and sixth in 1762, the seventh and eighth in 1765, and two new volumes of Sermons in 1766. Naturally of a weakly frame, his round of London gaieties so crippled his health that he was compelled to travel on the Continent in 1762–64, in the hope of recruiting it. He returned to Coxwold in the summer of 1764, leaving in France his wife, of whom he had grown weary, and his daughter Lydia, to whom he was fondly attached. He visited the Continent a second time, from October, 1765, to June, 1766, gathering the materials for his "Sentimental Journey." In 1767 he published the last volume of "Tristram," and made the acquaintance of a Mrs. Elizabeth Draper, the Eliza of the "Yorick Letters," who, however, soon returned to her Indian home.

The "Sentimental Journey" appeared early in 1768, and was as successful as any of his previous compositions. But its author was now too ill to enjoy the fruits of his renown. He lay at his lodgings at 41 Old Bond Street, sick of pleurisy, which was further complicated by an attack of influenza. On the 18th of March a fashionably gay party had assembled in Clifford Street, near his lodgings; Garrick and Hume were among the guests, and at their instance a footman was despatched to inquire after their friend Sterne's health. Conducted to the sick man's room he saw death in his face. He lay exhausted on his bed, and complaining feebly that his feet were cold, begged his nurse to rub them. She obeyed. The cold mounted higher up to his body, and the nurse rubbed his ankles and legs. In vain. Suddenly exclaiming, "Now it is come," he raised his hands as if to ward off a blow, and breathed his last. Sterne was buried on the 22nd of March, in the graveyard attached to St. George's, Hanover Square, but his body was probably stolen by the "resurrection men" and sold for dissection.

The following is a list of his works, and their date of publication:—"Tristram Shandy," vols. 1 and 2, 1759; Sermons, vols. 1 and 2, 1760; "Tristram Shandy," vols. 3 and 4, 1761; "Tristram Shandy," vols. 5 and 6, 1762: "Tristram Shandy," vols. 7 and 8, 1765; Sermons, vols. 3, 4, 5, and 6, 1766; "Tristram Shandy," vol. 9, 1767; "Sentimental Journey," 1768.

On the precise nature of Sterne's merits as an author, a great diversity of opinion exists. It may be admitted that they have been very severely treated by no less competent a critic than Thackeray. But after acknowledging that he was indebted for much of his humour to Rabelais and Scarron, much of his learning and reflection to Burton; after confessing that he was a most unscrupulous plagiarist, we cannot but claim for him a foremost rank among English humorists. His gold was not all his own, but the workmanship was original. It owed its graceful and fantastic shapes to the skill of the artist. Of him it may be truly said, he touched nothing which he did not adorn. He dressed up his borrowed thoughts so ingeniously that their fathers would scarcely have recognized them. And, after all, his *characters* are original. Uncle Toby, Corporal Trim, the Shandy family—these are true creations, and their author has filled them with some of that immortal fire which genius filches from heaven. Nor can it be said that he harped only on one string; his command over the feelings was exhaustive; he could reach the very sources of pathos; and a thousand eyes have grown dim with tears over the prisoner in his cell, the dead ass, and the sufferings of Le Fevre.

The life of Sterne has been fairly well written by Percy Fitzgerald. But the most adequate biography on a small scale is H. D. Traill's excellent work (1882), in Macmillan's English Men of Letters Series.

STERN'HOLD, THOMAS, was a native of Hampshire, and born towards the close of the fifteenth century. He was educated at Oxford, and held the post of groom of the robes to Henry VIII. and Edward VI., in whose reign he died, August, 1549. His only claim to distinction is, that he was the principal author of the first English metrical version of the Psalms attached to the Book of Common Prayer. He had undertaken to versify the whole of the Psalms, but completed only twenty-one; the rest were translated by John Hopkins and William Whittinghame. He was also the author of "Certain Chapters of the Proverbs of Solomon, drawn into Metre" (London, 1549, 8vo). The complete version of the Psalms by Sternhold and Hopkins was not published till 1562, when it was annexed to the Book of Common Prayer.

STER'NUM, the breastbone. See the article and Plates Backbone for a description and figure of the human sternum.

In man the sternum supports the ends of the ribs, as the spine supports their origins; but although the sternum is universal in vertebrates above the fishes (except the tortoise family, whose ventral plate, though it seems to be a sternum, is not one in reality), it does not always serve this function. For example, the frogs have a sternum but no ribs, or but rudimentary ones. Fishes and snakes, on the other hand, have a wonderful array of ribs, but no sternum. Still the sternum, used as a front support for the ribs, is by far the most ordinary form of its occurrence.

The sternum is very much broader in proportion to its length in birds (and in whales also) than in man; but in most Mammalia, as the dog for instance, in some reptiles, as the crocodile, and practically in all the Primates (monkeys, &c.), it is narrower in proportion to its length than in man. The gibbon almost alone has a broader shaped sternum than man. The enormous relative development of the lowest division of the sternum is a striking point in the skeleton of birds. Sometimes it extends in one sheet, as in the ostrich, sometimes in a median process and four lateral ones, as in the ordinary fowl. This large median process bears the keel, or the greater part of the keel, in birds, and the great pectoral flying muscles of the breast are attached to it.

STESICH'OROS, one of the earliest and most celebrated lyric poets of ancient Greece, was a native of Himera in Sicily, and probably born about B.C. 643. He is said to have lived to the age of eighty-three. His original name, according to Suidas, was Tisias, and he assumed that of Stesichoros because he trained and directed the solemn choruses of the religious festivals. He gave to the choral songs the artistic form which Pindar afterwards brought to perfection. The subjects of his poetry were from the mythical and heroic ages of Greece.

The best collection of his fragments is by Kleine, published at Berlin, 1828, 8vo. They are also contained in Gaisford's "Poetæ Græci Minores;" and in Bergh's "Poetæ Lyrici Græci."

STETH'OSCOPE, a simple medical instrument invented by Laennec in 1816. It is a narrow wooden cylinder, about half an inch in diameter, enlarging at each end and perforated in its axis. A very usual length is 7 inches, and many busy doctors have the stethoscope of just such a size as to fasten itself by pressure in the top of the hat. The stethoscope (Gr. *stethos*, chest; *skopeô*, I examine) is used for auscultation of the chest; that is, for examination of the sounds of the lungs and the heart. The end applied to the patient is of a little over an inch in diameter, and is purposely kept rather small, so that the sound may be traced over only a small area, and thus better localized: the end applied to the physician's ear is quite twice as large as this. Sometimes vulcanite is used instead of wood. The stethoscope collects and transmits to the ear the sounds within the chest, and does this so faithfully, and gives thereby such valuable information, that it seems wonderful how our forefathers managed without it.

There have been many attempts to improve the stethoscope. The best form at present in use has two ear-tubes with bluntly pointed ends, which the physician inserts into the orifices of his ears, the tubes having sufficient elasticity to allow him to separate them far enough to pass them over his head for that purpose. The two tubes meet in front in a common trunk, which ends in the usual chest piece. The physician thus hears with both ears at once, has not to lean his head sideways, or take any unusual or uncomfortable position, and is not obliged to approach within a few inches of his patient, a matter of some considerable advantage on occasion.

Another application is that of Koenig, to enable several observers to auscultate at once. Two sheets of india-rubber form the top and bottom of a small thin disc-like chamber, whose rim is of metal; a small tube allows of the

chamber being inflated so that the sheets are stretched and take a drum-like tension. The chamber is adjusted to a metal cup, which it exactly closes, and from which pass several flexible ear-tubes with suitable tips for insertion in the ear. The vibrations of the chest-sounds are caught by the india-rubber chamber and transmitted to the air in the cup, and so along the flexible tubes to the observers.

STETTIN', a fortified town of Germany, in Prussia, the capital of Pomerania and of the government of Stettin, a flourishing commercial and river port, situated on an eminence on the left bank of the Oder, where it flows into the Stettiner-Haff, at a distance of 80 miles by railway north-east from Berlin. In 1881 it had 91,756 inhabitants. The Oder divides at Stettin into four arms, which are crossed by bridges connecting the town with several suburbs. The harbour was greatly improved in 1877. The town, which is entered by five principal gates, has several squares, in one of which is a statue of Frederick the Great, and also all the principal government offices of the province. Owing to its being built on a hill the streets are steep, but the houses are good, and the suburbs very pleasant. Of the public buildings the most remarkable are—the Schloss, formerly the residence of the dukes of Pomerania, the Schloss-Kirche, the churches of St. Peter and St. Paul and St. Jacobi, Roman Catholic chapel, government house, arsenal, house of the provincial estates, mint, exchange, barracks, three hospitals, and a theatre. Besides the gymnasium, to which an observatory is attached, there are a medical college, a school of navigation, and several other educational establishments and charitable institutions. The manufactures are principally silks, woollens, linen, cotton, leather, hats, stockings, ribbons, machinery, cement, sailcloth, ship-anchors (made in very large numbers), sugar, spirits, soap, and tobacco. There is some shipbuilding. The trade of Stettin is very considerable, it being the chief port for the manufactures and produce of Silesia, and for the importation of all kinds of foreign goods for the supply of Silesia, Berlin, and other places. Large vessels anchor at Swinemünde, and their cargoes are conveyed to Stettin in lighters. An iron floating dock was completed at Starkenhorst, opposite Swinemünde, in 1869. It is built for vessels of the Prussian royal navy, but when not required by them is used by merchant vessels. The Oder is navigable for barges as far as Ratibor, near the extreme southern boundary of Silesia, and is united by means of canals with the Vistula, Elbe, and the Spree. By means of the railway to Pesth—644 miles distant—much produce is forwarded from Hungary to England *via* Stettin. The trade is chiefly a transit one. Two empresses of Russia, Catharine the Great and Maria Feodorovna, wife of the Emperor Paul and mother of Nicholas, were born at Stettin. The town is a place of great antiquity. In 1121 Boleslas, duke of Poland, gained possession of it, and introduced Christianity. The peace of Westphalia gave it to the Swedes. From them it passed to the Prussians, with whom, though not without some interruptions, it has since remained. From 1806 to 1813 it was occupied by the French.

STEVENS, ALFRED G., who has earned a title to the remembrance of posterity as the sculptor of the Wellington Monument in St. Paul's, the one work of real superlative excellence in sculpture of which the middle of the nineteenth century can boast, was born in 1817, at Blandford. His genius early manifested itself, and he was sent to Italy to study. Thorwaldsen discovered him, and gave him much work. On his return to England Stevens produced splendid decorative works in sculpture, painting, and metal, but as these were chiefly in the hands of private persons he was still unknown to the public at large. He was careless of publicity, and rarely exhibited; but the marvellous beauty of his designs, especially for metal work, many fine specimens of which have been collected at the South Kensington Museum, brought him constant commissions from manufacturers. Fortunately Stevens was induced to compete for the Foreign Offices and the Wellington Monument, and though he lost the first he won the second. We have therefore a magnificent specimen of what he would have achieved had his temperament and the circumstances of the times permitted his powers for the execution of great works to be more fully called forth. Unfortunately great public opportunities are rare; and as for himself, he was the despair of his admirers, quite impracticable and unworkable, never satisfied with his work, continually creating superb designs, one after the other, only to destroy them as not realizing his ideas; and that, too, at times when rapid production was required for his own needs and the public satisfaction. Work had to be dragged from him; if left to himself he would always find something he could improve. Fortunately the design for the Wellington Monument was left in a finished state, though he himself was unsatisfied, and was still retouching it when he died (1st May, 1875). The work, whose delay had long caused annual angry debates in Parliament, was rapidly completed when its great designer was once away. The two bronze groups of the monument, "Truth plucking out the tongue of Falsehood," and "Valour triumphing over Cowardice," are really grand productions, showing how intimately Stevens was penetrated by the spirit of Michelangelo. The general design of the tomb seems to have been inspired by the high altar and tomb in SS. Giovanni e Paolo, at Venice, which Camero designed in 1610.

The absence of the group which should crown the Wellington Monument, and its shamefully inadequate position, crammed into a small side chapel of St. Paul's where it is impossible to be seen, prevent even yet the proper appreciation of Stevens' masterpiece.

Stevens lived like a hermit, and was always hard at work, but his unfortunate habit of over-fastidious self-criticism prevented his enriching the world to the extent which a more practicable man would have easily attained. He was not only a sculptor and designer, but also a capable architect and painter, and had great skill in music, realizing, indeed, much of the character of the great versatile Italians of the Golden Age. He resided at Sheffield from 1850 onwards for some years, and under his fostering influence the Sheffield School of Art became a great power in the land. The well-known decorative artist, Mr. Godfrey Sykes, was one of the pupils of Stevens.

STEVENS, RICHARD JOHN SAMUEL, a musical composer, was born at London, in 1757, and died in 1837. Stevens was organist to the Temple Church, London, then to the Charterhouse, and in 1801 succeeded Dr. Aylwood as professor of music in Gresham College. His five-voiced glees, from Ossian, "Some of my Heroes are low," and from Shakespeare, "The cloud-capt Towers;" and the familiar favourites, "Ye spotted Snakes;" "Blow, blow, thou winter Wind;" "Crabbed Age and Youth," and "Sigh no more, Ladies," all to words of our immortal dramatist, are among the best-loved pieces of our native music. Their freshness and originality is undiminished by time, and their popularity actually seems to increase.

STEVENSON, SIR JOHN ANDREW, Mus. Doc., a musical composer, was born in Ireland in 1762, and died at Dublin in 1833. He received his education in the choir of St. Patrick's Cathedral, of which foundation he afterwards became a vicar-choral. The degree of doctor of music was conferred on him at Trinity College, and he received the honour of knighthood from the lord-lieutenant. He composed many glees and some dramatic music; but the work by which he is now alone known is Moore's "Irish Melodies," to which he composed symphonies and accompaniments, many of them, it may be said, highly inappropriate.

STEVENSON, ROBERT, an eminent Scotch engineer, was born at Glasgow on the 8th of June, 1770. While he was yet a child he lost his father, a merchant connected with the West Indian trade; and his mother contracting a second marriage with Mr. Thomas Smith, the first engineer of the Lighthouse Board, young Stevenson was naturally led to adopt his stepfather's profession. Such was his assiduity, and such his natural capacity, that at the age of nineteen he was intrusted with the erection of a lighthouse on the Little Cumbrae, an island off the Ayrshire coast of Scotland. In 1796 he succeeded to his father-in-law's office, which he held for forty-seven years. In this long period he completely revolutionized the lighthouse system which prevailed on the Scottish shores; planned and constructed no fewer than twenty-three lighthouses, of which the most remarkable were those on the Bell Rock, near Arbroath, and on the SKERRYVORE, near Tiree; introduced what is known as the "catoptric system of illumination;" and invented the "intermittent" and "flashing" lights. In other branches of his profession he displayed the same fertility of resource and inexhaustible ingenuity, and his name is associated with many of the best roads, canals, harbours, and bridges in Scotland. He died in Edinburgh on the 10th of July, 1850, in his seventy-ninth year. His literary productions were all of a strictly professional character; yet the general reader cannot fail to be interested in his narrative of the difficulties attendant on the erection of the Bell Rock Lighthouse.

STEW'ARD, LORD HIGH, one of the ancient great officers of state of England. Under the Norman and the early kings of the Plantagenet line this seems to have been a hereditary office. It passed to the great family of Leicester, and so to the De Montforts. Upon the attainder of Simon de Montfort in 1265 it was resumed by the crown; but Henry III. regranted it to his son Edmund, creating him Earl of Leicester at the same time. The Earls of Lancaster and Leicester continued to hold it afterwards. It was merged in the regal dignity in the person of Henry IV., who was himself Earl of Lancaster, and since that time the title and office have only been reserved for particular occasions; the office now ceases when the business which required it, and which has usually been when a person was to be tried before the House of Peers, is ended. On these occasions a lord high steward is created. He presides at the trial, and when the proceedings are closed, breaks his wand, and dissolves the court; but if the proceedings take place during the session of Parliament, though a lord steward is appointed, it is not considered as his court, for he has no judicial functions, and only votes with the rest as a peer.

The *Lord High Steward of Scotland* held a similar office to the foregoing during the twelfth, thirteenth, and fourteenth centuries. He was chief of the household, managed the crown venues, and occupied in battle the first place in the army next to the king. The stewardship was merged in the crown on the succession of Robert II., who was the seventh occupant of the office; but the estates of the stewards afterwards became the appanage of the king's eldest son, and by an Act of the Scottish Parliament in 1469, the titles of Prince and High Steward of Scotland, Duke of Rothesay, Earl of Carrick, Baron Renfrew, and Lord of the Isles were vested in the eldest son and heir-apparent of the crown of Scotland for ever. The Prince of Wales is now, therefore, the holder of this ancient office.

STEW'ART, DUGALD, the son of Dr. Matthew Stewart, was born in Edinburgh, 22nd November, 1753, and was educated at the High School of that town. In the winter of 1772 he attended the course of lectures delivered by Dr. Reid at Glasgow; his love for metaphysical speculation was roused, and he wrote an "Essay on Dreaming," which he afterwards incorporated in his "Elements of the Philosophy of the Human Mind." He was then in his nineteenth year. Having completed his studies at Glasgow, he assumed the charge of the mathematical classes hitherto taught by his father in the University of Edinburgh, and on coming of age he was appointed mathematical professor.

On the retirement of Dr. Ferguson in 1785, he was appointed his successor in the chair of moral philosophy. His first work was the "Elements of the Philosophy of the Human Mind," the first volume of which appeared in 1792. In 1793 he published his "Outlines of Moral Philosophy," a text-book for his pupils; and the "Life of Adam Smith," which appeared in the *Transactions of the Royal Society of Edinburgh*; followed by the "Life of Dr. Robertson" in 1796, and the "Life of Dr. Reid" in 1802. His activity was unceasing; and in 1800 he added a series of "Lectures on Political Economy" to his heavy professional duties, but they were not continued. In the winter of 1808-9, from grief at the loss of his younger son, which brought on a severe indisposition, he was obliged to have a deputy to discharge his professional labours, and in the following session he resigned them altogether. The fruits of his retirement were not slow in manifesting themselves; in 1810 appeared his first volume of "Philosophical Essays;" in 1814 the second volume of his "Elements of the Philosophy of the Human Mind;" and in 1815 his celebrated Preliminary Dissertation to the Supplement of the *Encyclopædia Britannica*, entitled "A General View of the Progress of Metaphysical, Ethical, and Political Science since the Revival of Letters;" a work for which his discursive reading well fitted him. In spite of the desultory and careless character of this discourse, its want of unity and any comprehensive principle, Sir James Mackintosh declared it to be "the most splendid of Mr. Stewart's works."

In 1828, a few weeks before his death, he published his "View of the Active and Moral Powers," by far the least exceptionable of his works. He died 11th June, 1828, and was buried in the Canongate churchyard, Edinburgh. His collected works, with a life by Professor Veitch, and edited by Sir William Hamilton, have been published in eleven vols. The ethical teaching of Dugald Stewart was the old-fashioned doctrine of the Moral Sense, or, as he preferred to call it, the Moral Faculty (because he regarded the suggested analogy with the physical senses as misleading); an innate and intuitive perception of right and wrong as clear and natural as the perception of blue and red, or of bass and treble. He makes a point of the existence in all languages of different words for *duty* and for *interest*, and he refers to the moral judgments of children and ignorant persons unable to act upon a reasoned course. He overlooks the obvious reply to this from the facts of heredity, and makes but a lame defence against the objections that moral judgments differ with age, sex, country, race, period, and surrounding circumstances.

STEW'ARTS. See STUARTS.

STEW'ARTON, a town and parish of Scotland, in Ayrshire, beautifully situated on a semicircular sweep of the Annich, 18 miles south-west by south of Glasgow, and 393 from London by rail. Dating as a village from ancient times it is now a growing town, with a population in 1881 of 3130, with a prosperous manufacture of woollen goods, especially military forage caps and carpets. It has also dyeing and spindle-making works. There are parish, Free, and U.P. churches, and Wesleyan and Congregational chapels, a public library, and the usual business offices. The population of the parish in 1881 was 4809.

STEY'ER, a manufacturing town in Upper Austria, 90 miles west by south from Vienna, with 15,000 inhabitants, stands on the fork between the Enns and the Steyer, which rivers are crossed by bridges leading to the two principal suburbs, Enns-dorf and Steyer-dorf. The Castle of Steyer

the family seat of Count Lamberg, on a hill on the right bank of the river, the Dominican church in the great square, the ancient parish church with its lofty tower, the old and new town-house, the theatre, the barracks, and the hospitals, are the most remarkable structures in the town. Steyer has paper, hosiery, and woollen and cotton manufactures, but is chiefly famous for its Steyer-steel goods, fire and side arms, ironmongery, razors, files, &c. This place is, in fact, the great seat of the iron and steel manufactures of Austria; and besides being largely consumed in the country, the goods made in it are exported to Switzerland, Turkey, and the Levant.

STHEN'IC DISEASES (Gr. *sthenos*, strength), in medicine, those diseases which are produced by inflammatory or increased action, and are consequently the opposite of *asthenic*, which result from enfeebled action or debility.

STIB'NITE or **ANTIMONY GLANCE,** sometimes called *Gray Antimony*, is the principal ore of antimony, and has the chemical formula Sb_2S_3, being a sulphide of the metal. The mineral has been known from the earliest times, especially in the East, where for centuries it has been powdered and used by the women in painting the eyebrows and eyelids; its Arabic and Hebrew name is *kohl*, which enters into the term *alcohol*, a word used in the middle ages to designate any fine powder. Stibnite has a metallic lustre, and is ordinarily of a steel-gray colour; it melts in the flame of a candle, and when more strongly heated gives off obnoxious sulphurous and antimonious fumes. It usually occurs in veins, often as bunches of long prismatic crystals, and it is occasionally met with in our own country, in the mines of Cornwall and Dumfries. The mineral also occurs in numerous mining localities on the Continent and in America; but the largest quantities are found in Borneo, whence most of the ore employed in commerce is obtained.

STICK, GOLD, the title of the two colonels of the regiments of Life Guards, whose duty it is to be in direct attendance upon the sovereign on all occasions of state and ceremony. They do duty for a month alternately, and the one on duty is called the "Gold Stick in Waiting." The field officer of the same regiment while on duty is known as "Silver Stick." The term originated in the ancient custom of the sovereign to present the colonel of the Life Guards with a gold stick on his appointment to his regiment.

STICKLEBACK (Gasterosteus) is a genus of fishes belonging to the order ACANTHOPTERYGII, and to the family Gasterosteidæ, of which it is the sole representative. About ten species are known, principally found in fresh and brackish waters in Europe and North America. They are small fishes, elegant in form and brilliant of colour. The body is elongated and compressed, without scales, but protected by large plates on the sides. There are from three to fifteen free spines in front of the soft dorsal fin; the ventral fins are abdominal in position, and reduced to one strong spine and a small ray. The snout is generally more or less produced, the mouth small, and the jaws furnished with very small crowded teeth.

The sticklebacks are remarkable for their pugnacity, voracity, and the rapidity of their movements. They feed to a large extent on the fry of other fishes, doing great damage in aquaria or ponds stocked with fish; they feed also on aquatic insects and worms. The males are brilliantly coloured at the breeding season, and engage in furious combats one with another, inflicting severe bites, and using the spine of their ventral fins as a weapon, often with fatal effect. The males also construct nests for the reception of the eggs, and guard both the eggs and the young fry from molestation.

The Common or Three-spined Stickleback (*Gasterosteus aculeatus*) has three spines in front of the soft dorsal fin. It is about 3 inches long. This fish is found in abundance in almost every pond and rivulet in Great Britain, and also on the Continent. They sometimes swarm in very great numbers, and are collected for manure. In the summer the male constructs in a hollow on the bottom of the stream a nest of stalks of grass and other substances, which he cements together by mucus exuded from the skin. A small hole is left on one side of the nest as an entrance, into which, with many caresses, he entices the female to whom he is paying court. The female passes into the nest, and deposits her eggs, which the male fertilizes, and then the female makes her way out on the other side. The male brings the same or a fresh mate again to the nest till it contains a large number of eggs. Then for a whole month the male fish remains guarding his treasure, swimming over and around it, wafting currents of water over the surface of the eggs, and driving away all intruders, especially his wives, with the greatest ferocity. When the eggs are hatched, in about a fortnight, he watches over the young fry with the tenderest care, defending them against the attacks of other fishes, and keeping them in the vicinity of the nest till they have gained strength to swim away and take care of themselves.

The Ten-spined Stickleback or Tinker (*Gasterosteus pungitius*), another British fresh-water species, constructs a nest among aquatic plants, and shows the same fostering care of its offspring.

The Fifteen-spined Stickleback (*Gasterosteus spinachia*) is a marine species, found in the seas of Northern Europe. It is from 5 to 7 inches long, and has the first dorsal fin composed of fifteen spines. This species builds its nest in harbours or other sheltered spots. The nest is constructed of seaweeds and coralline, and forms a pear-shaped mass 5 or 6 inches long, and about as stout as a man's fist. According to Couch the materials are bound together by an elastic thread, resembling silk, which when magnified appears to consist of several strands connected by a gluey substance, which hardens on exposure to the water. The nest is guarded by the male with the same care as in the other species. Several species are found in the United States displaying the same parental instincts.

STI'GAND, a celebrated Saxon prelate, was the first priest of the minster of Assandun, founded by Cnut the Great and Earl Thurkyll, after the victory over Edmund Ironsides. Later on he was a great favourite of Edward the Confessor, whose chaplain he was. In 1043 he was elevated to the see of Emham, which comprehended the modern bishopric of Norwich. In 1047 he was appointed Bishop of Winchester, and in 1052 became Archbishop of Canterbury, Robert the Norman being deposed by the great council and driven into exile. Stigand was considered an intruder, and, unpopular as was his assumption of the dignity of another, he added still further to the scandal by retaining the see of Winchester. In spite of the most tempting offers the Pope would never grant him the pall. But a schism occurred in the Romish church—Benedict, the antipope, usurping the chair of St. Peter. Stigand paid court to Benedict, and obtained the pall as the price of his acknowledgment of his claims. For this offence he was afterwards interdicted by the holy see, but he managed to retain his position. At the coronation of Harold it was felt that the unacknowledged dignity of Stigand might lead to questionings of the legality of the coronation; and therefore Harold was crowned by Ealdred, archbishop of York. At the coronation of the Conqueror also the honour of placing the crown on the head of William was refused to Stigand, who was present at the ceremony, and again conferred on Ealdred. Perhaps it was because of his thrusting out Archbishop Robert the Norman, or perhaps it was because of the part Stigand had taken in the election of Edgar the Atheling as king after the death of Harold, certainly, for whatever reason, William disliked Stigand, and besought the Pope to depute

three cardinals to inquire into his conduct. Stigand fled to Scotland, but afterwards surrendered. In 1070 he was tried at Winchester, deposed, and confined for life. He was found starved to death in prison, perhaps by his own voluntary act. Round the neck of the unfortunate man was found a key, which opened certain secret recesses in which he had hoarded up his immense wealth. He was ignorant and avaricious, and his fall was lamented by neither Saxon nor Norman.

STIG'MA, in botany, is the glandular surface at the apex of the PISTIL in flowering plants, to which the pollen adheres when it fertilizes the ovules. Sometimes the stigma is sessile on the ovary, but most generally it is situated at the apex of a slender column, the style.

STIGMA'RIA. See SIGILLARIA.

STIG'MATA (Gr. *stigma*, a mark; plural, *stigmata*), the marks of the wounds inflicted on our Saviour when he suffered crucifixion. About these much miraculous lore has grown up; and the legends of the older churches are full of instances of their miraculous impression on the bodies of certain favoured saints. To St. Paul's expression, "I bear in my body the marks of the Lord Jesus," we may probably trace the origin of the belief in "stigmatization," as it is called.

We have a very precise account of the manner in which St. Francis of Assisi received the stigmata two years before his death, and as this is so thoroughly well authenticated it may be cited as an example of similar miracles. Francis had retired to the mountain of Alverno to fast, in honour of the archangel Michael. One day, the 15th September, 1224, a six-winged seraph appeared before him, bearing with him the image of the Crucified, and touched him. He had for some days been perplexed because the Scriptures opened with persistence at the accounts of the passion when he consulted them; and now, when the angel had left him, and he recovered from the trance into which he had fallen, he found that he himself bore the marks of crucifixion. His hands and feet showed black warty marks on each side, on the one side of the shape of a large nail-head, and on the other of a nail-tip, bent over and clenched. It looked just as if the extremities had been bored and pierced with nails, as in crucifixion, and these nails had become hard flesh. A wound had broken out also on his side, in the same position as the wound given to Jesus by the lance of the soldier, and this wound bled at intervals. The marks on hands and feet could not well be concealed, although St. Francis endeavoured, with his usual humility, not to parade the great honour which these marks seemed to grant him; but the wound in the side he was most careful to hide, and few saw it while he lived. Among other persons of eminence St. Bonaventura saw it, and Cardinal Rinaldo, afterwards Alexander IV., also saw it. But when Francis died, 4th October, 1226, and in pursuance of a vow left the world naked as he came into it, all the stigmata were visible to all his disciples and to many others who came to lament over and to adore the saint's body.

The rival order of friars, the Dominicans, were jealous of the unheard-of miracle, and offered several explanations of a rationalistic nature. No one at the time, however, had any doubt as to the existence of the stigmata, whatever their origin, and the character of St. Francis puts out of all question any conscious deception on his part. Those who credit miracles at all must admit this, which is vouched for by multitudes of witnesses of all degrees; while those who refuse to accept miracles consider that perhaps Francis inflicted the wounds upon himself while in the unconsciousness of the trance following prolonged and persistent fasting, and renewed them from time to time upon like occasions. This, however, does not account for the black colour, nor for the hardness of the excrescences.

Other cases of recipients of the stigmata which best bear investigation are Angelo del Paz, a Franciscan monk of Perpignan; Dodo, a Premonstratensian monk; and Nicholas of Ravenna, a Franciscan. A Capuchin monk, Benedict of Reggio, received stigmata of the crown of thorns in 1602; and a certain Carlo di Saeta bore the wound in the side. Among women the most eminent stigmatist is St. Catharine of Siena, but she showed no external signs, though she felt constant excruciating pain in the positions of the various wounds. The most recent one is the sister Estatica of Caldaro, who showed all the marks in 1842. Others are Gabriella da Piezolo of Aquila (1472); Clara di Pugny, a Dominican nun (1514); Cecilia di Nobili of Nocera (1655); and Hieronyma Carvaglio, all of whom bore the mark of the lance-wound in the side. Several women during the middle ages bore the marks of the crown of thorns, as Catharine di Raconisio (1583), Maria Razzi of Chio, Maria Villani, Vincenza Ferreri of Valencia, &c. Veronica Giuliani, in 1694, bearing already the marks of the crown, received all the marks of the crucifixion in addition. Except the not very clear case of the modern Estatica, this seems to be the only case in which a woman claims to have received all the stigmata.

It is noteworthy that so many of these cases bear either the marks of the crown or of the lance-wound separately; and it is certainly possible in many of these cases that the accidental occurrence of a sore in the side may in all good faith have been twisted by ignorant mystical enthusiasts into a higher meaning than surgeons of the nineteenth century would give it; while the now well-known fact that long mental agitation produces curious physical effects on the skin and the tissues may account for much of the other class of appearances. It is quite possible, as any one may easily prove, to "think a pain" into almost any particular part of the body—*e.g.* the palm of the hand. Nervous persons can really hurt themselves in this manner. No doubt the pains felt by St. Catharine were due to some such cause. The last thing one ought to do is to imagine a noble character, such as St. Francis or St. Catharine, as a trickster or a victim of a vulgar delusion; and it is necessary either to believe the miracle or to explain it on natural grounds.

STIL'BENE or **PIC'RAMYL** is a hydrocarbon obtained by heating the hydride of sulphobenzoyl. It may also be prepared by the action of sulphide of ammonium on the oil of bitter almonds. It crystallizes in colourless plates, having the formula $C_{14}H_{12}$. It is soluble in boiling alcohol and in ether, and also in fuming sulphuric acid. It melts at 100° C. (212° Fahr.), boils at 292° (557° Fahr.), and distils unchanged. With boiling nitric acid it yields nitrostilbene ($C_{14}H_{11}NO_2$), and with chlorine and bromine several chloro- and bromo-stilbenes.

STILET'TO, a small thin dagger, sufficiently resembling the STILUS of the ancients in shape to be named after it.

STIL'ICHO, FLA'VIUS, was of Vandal origin, and his father was a captain of barbarian auxiliaries in the reign of Valens. Concerning his early life we know nothing beyond the vague eulogies of Claudian. He was sent when young by Theodosius on a mission to Persia, and rewarded for his success in the negotiation with the hand of Serêna, the emperor's niece. He was promoted from one office to another, until he became master-general of all the cavalry and infantry of the Western Empire.

In 393 Stilicho and Timasius commanded the Roman forces which Theodosius opposed to Eugenius. Theodosius gave the Empire of the East to his son Arcadius, under the guidance of Rufinus; and to his other son, Honorius, the Empire of the West, with Stilicho for his guardian. Honorius was a mere child, and had no ability, and Stilicho really possessed the imperial power in the West after the death of Theodosius.

In 400 Alaric advanced from Illyricum to invade Italy;

being checked in his progress by the siege of Aquileia, he withdrew towards the Danube to strengthen himself. In 402 he advanced upon Milan while Stilicho was absent. The latter returned just in time to save the emperor, who had fled before the Goths. He defeated Alaric at Pollentia on Easter Monday, 403. Peace was then concluded, and the Gothic king retired across the Po, followed by a Roman corps to watch his movements. He was a second time defeated at Verona, and Stilicho was rewarded with a splendid triumph.

Italy was again invaded in 405 by Radagaisus, at the head of a large body of Germans, and crossing the Po he entered Etruria. He was on the point of taking Florence when Stilicho surrounded the barbarians, and with the aid of famine and disease compelled them to surrender. Radagaisus was put to death, and the barbarians were sold for slaves.

The province of Gaul, from which Stilicho had been obliged to withdraw the garrisons, was invaded about the end of 406 and the beginning of 407 by Vandals, Alani, Suevi, Burgundians, and other Germanic tribes. In Gaul these barbarians were opposed by Constantine, who had shortly before been raised from the condition of a common soldier to the rank of emperor by the soldiers in Britain, and now made himself master of Gaul and Spain by entering into a league with some of the barbarians.

Before the invasion of Radagaisus, Stilicho had made a treaty with Alaric with the view of inducing Honorius to go to war with his brother. Alaric now demanded his subsidies; and the senate at Rome was induced by Stilicho's influence to buy off the barbarians with 4000 lbs. of gold.

In May, 408, Arcadius died, leaving a son, Theodosius, eight years old. Honorius proposed a journey to the East to regulate the administration. Stilicho represented to him the dangers of such an undertaking, and it was determined that the great general himself should go to Constantinople. The eunuch Olympius now represented to the emperor that Stilicho was conspiring with Alaric, and also contrived to influence the soldiers at Pavia, who revolted, and killed several of their principal officers, friends of Stilicho. As soon as the intelligence of the revolt at Pavia had arrived, Stilicho's counsellors advised him to march against his enemies, but he hesitated till it was too late. At midnight Sarus, a Goth, made an attack upon his tent, and cut down his guards. He escaped to Ravenna, and took refuge in a church. He was treacherously induced to come out, and as soon as he had left the threshold he was put to death by Count Heraclian, who was waiting for him with a band of soldiers, on the 23rd of August, 408. His family and his friends were persecuted, and many of them put to death.

The history of Stilicho has come down to us in a manner which scarcely enables us to choose a due medium between the extravagant praise of Claudian and the charges of his enemies, or of such writers as were obliged to join in the general clamour that was raised against him after his fall.

STILL. See DISTILLATION.

STILL, JOHN, the son of William Still, of Grantham, in Lincolnshire, was born in 1543, and became a student of Christ's College, Cambridge. In 1570 he was appointed Lady Margaret's professor in the university. He afterwards held livings in Suffolk and Yorkshire, and was successively master of St. John's College and Trinity College. In 1588 he was chosen prolocutor of the convocation; and in 1592 he was raised to the bishopric of Bath and Wells, which he held till his death in 1607. The historians of the drama concur in believing him to have been the author of a coarse but humorous play, which, till the recent discovery of "Ralph Royster Doyster," was held to be the earliest extant work known in England by the name of a comedy. It is called "a ryght pithy, pleasaunt, and merie Comedie, intytuled, 'Gammer Gurton's Nedle:' played on stage not long ago, in Christe's Colledge in Cambridge. Made by Mr. S., Master of Art" (1575). "Gammer Gurton's Needle" is included in Hawkins' "Origin of the English Drama," and in the second volume of Dodsley's "Old Plays." The whole plot turns on the loss of the good gammer's needle while mending her man's clothes.

STILLINGFLEET, EDWARD, an eminent controversial theologian, was born at Cranbourne, Dorsetshire, 17th April, 1635. He entered St. John's College, Cambridge, in 1648, and obtained a fellowship in 1653. After taking his degree of M.A. he was private tutor in the families of Sir Roger Burgoin and of the Hon. Francis Pierrepoint. In 1657 he was presented to the rectory of Sutton.

In 1659 he published his first work, "Irenicum, or the Divine Right of particular Forms of Church Government examined," which was intended to prove that no particular form of church government is appointed in the New Testament; but this opinion he afterwards retracted. The work on which his reputation mainly rests is his "Origines Sacræ, or Rational Account of the Christian Faith as to the Truth and Divine Authority of the Scriptures," published in 1662.

Stillingfleet was an indefatigable polemic. During the greater part of his life he had his hands full of controversy, with the Romanists on the one side and the Nonconformists on the other. In the year 1664 he engaged, at the request of Dr. Henchman, bishop of London, in the defence of the views maintained by Laud in his conference with Fisher the Jesuit. In 1665 he was presented to the rectory of St. Andrew's, Holborn, London, having been already made preacher at the Rolls Chapel. This was speedily followed by his appointment as lecturer to the Temple, and chaplain in ordinary to Charles II. In 1668 he took the degree of D.D., and was nominated by Charles in 1670 canon residentiary of St. Paul's, and in 1678 dean of the same cathedral. In the meantime he published his "Discourse concerning the Idolatry practised in the Church of Rome, and the Hazard of Salvation in its Communion" (1671); other tracts against the Roman Catholics, and also against the Socinians; and "A Letter of Resolution to a person unsatisfied about the Truth and Authority of the Scriptures."

In 1680 he plunged into a new controversy with Owen, Baxter, Howe, and other eminent Nonconformists. He advocated his views in a large quarto volume, entitled "The Unreasonableness of Separation" (1681), in which he traces the history of Nonconformity; and Baxter rejoined in "A second true Defence of the mere Nonconformists, against the untrue Accusations, Reasonings, and History of Dr. Edward Stillingfleet" (1681), to which the dean made no reply. In 1685 he published his "Origines Britannicæ, or Antiquities of the British Churches."

After the revolution of 1688 Stillingfleet's services to the Protestant cause were rewarded with the bishopric of Worcester, to which he was consecrated in 1689, and which he held for ten years.

In the latter part of his life he engaged in a sharp controversy with Locke, on the latter's definition of substance and theory of ideas in general. In this instance he was signally defeated, and his chagrin at the result is said to have hastened his death, which took place at Westminster, 27th March, 1699. His works were printed in 1710, in six vols. folio, and a volume of his miscellaneous works was published in 1735 by his son, the Rev. James Stillingfleet, canon of Worcester. Stillingfleet had collected a splendid library, which Dr. Marsh, archbishop of Armagh, purchased in order to throw it open to the public in Dublin. The MSS. were bought by the Earl of Oxford, and are now in the Bodleian Library.

STILLIN'GIA. See TALLOW TREE

STIL'PO was an influential philosopher of the Megaric school, and lived during the time of Alexander the Great (350-323 B.C.) His life was passed principally in his native town, to which crowds of disciples were attracted by the fame of his instructions. The Megaric sect was a prolongation of the Eleatic, modified by Socratic influences. It was famous for those logical puzzles which sometimes present real difficulties, but are for the most part mere quibbles, or a play upon words. For example, Does a grain of corn make a heap? No. Do two grains? No. Three? No; and so on until the answer is Yes, now there is a heap: on which the absurdity emerges that one grain makes the difference between a heap and no heap of corn. To these exercitations Stilpo's principal contribution seems to have been the statement that "No one thing can be predicated of another, because no two things are the same;" from whence it follows that the only true propositions are those in which the predicate is identical with the subject. Thus we may say "Man is man," but not "Man is good," inasmuch as *good* is different from *man*, and therefore to say "Man is good" is equivalent to saying "Man is not man," which is a contradiction. But as none of the writings of Stilpo have come down to us we are scarcely in a position either to understand or to criticise his doctrine. In morals Stilpo inculcated apathy, or an insensibility to the evils of life, as the chief good of the soul. He was the instructor of Zeno, the founder of the stoical philosophy.

STILT (Himantopus) is a genus of wading birds (GRALLÆ), belonging to the family SCOLOPACIDÆ. The stilts are nearly allied to the AVOCET (Recurvirostra), which they resemble in the length of the legs and bill. The bill is very long, slender, and straight, slightly recurved at the tip. The legs are also very long and slender, with three toes in front, united by a membrane. The wings are very long.

The Black-winged Stilt (*Himantopus candidus*) breeds in Southern Europe, Southern Asia, and Africa, and visits Northern Europe, and occasionally England. The back and wings are nearly black, with a slight green tinge; the rest of the plumage is white, with an evanescent rosy tint; the legs and toes are pink, and the bill is black. The total length is about 13 inches. The stilt feeds on flies, beetles, and aquatic insects, wading in shallow water to catch its prey. The nest is placed in a tuft of grass near the water, and contains four eggs. The Black-necked Stilt (*Himantopus nigricollis*) is found on the Atlantic coasts of North America in company with the American avocet. It is slightly larger than the preceding species, from which it is distinguished by its black head and neck. Several other species of stilts are known, distributed over all parts of the world.

STILTED ARCH, the typical arch of the Moorish style of architecture. It has the capital or impost mouldings of the jambs below the level of the springing of the curve, the moulding of the arch being continued vertically down to the impost mouldings. See the plate MOORISH ARCHITECTURE.

STI'LUS, a kind of pencil employed by the Romans for writing on waxed tablets. It was made of iron or brass, sharpened to a point at one end, for scratching the characters upon the wax, and flat and circular at the other, to render the surface of the tablets smooth again, and so to obliterate what had been written. Hence the phrase *vertere stilum* means to erase, and, therefore, to correct, as in the well-known Horatian precept *Sæpe stilum vertas*, be careful to correct frequently (Horace, "Satires," book i.) This constant reference to the use of the stilus caused purity of diction and taste of expression, which can only be attained by frequent corrections, to be spoken of as "style." Among the Romans, however, the term, in this figurative application of it, always retained considerably more of its antecedent meaning than it does with us. We say not only style of writing and style of speaking, but style of painting, style of architecture, style of dancing, style of dress, style of anything in which form or manner is conceived to be, in however slight a degree, expressive of taste or sentiment—if even this much of distinction still remains between what is called style and mere manner in the widest or loosest sense.

Style, in writing or speaking, may of course mean a bad style as well as a good style. Yet when the word stands alone, we always understand it in the latter sense—just as when we speak of expression in painting, or in music, we mean just or forcible expression.

STIMULANTS differ from true foods both in the rapidity of their action on the body and in the nature of it. True foods are somewhat slowly absorbed and take some time to act, but their action always is permanently to increase some or all of the vital functions; they renew some structure or maintain some process by supplying the body with material. Stimulants on the other hand act, speaking generally, very quickly, and, when not used to any large extent, transiently; they renew no structure and supply no material to the body, but they modify vital action, oftentimes to a surprising degree, during their period of activity. A frequent effect of stimulants is an apparent increase of vitality, whence they derive their name; but this is followed in the case of many of them, as for instance alcoholic drinks and the ethers, by a corresponding depression, extending even to coma; so that their ultimate is the reverse of their immediate action. Stimulants, when used largely, in fact result in depression, just as purgatives result in constipation and narcotics in wakefulness. The pendulum of nature, when violently swung, demands its return swing.

Alcoholic Stimulants.—The consideration of the action of alcoholic stimulants upon the body is rendered perplexing, even in truly scientific minds, by the terrible result of their abuse. This element, fortunately, does not enter into the study of the non-alcoholic stimulants, such as tea, coffee, and cocoa. But with spirits, ethers, wines, and beers the demon of intoxication lurks so close by the drinker that at any moment the fatal craving may seize upon its victim, and health, happiness, reputation, and fortune may be attacked, and may not improbably vanish under its irresistible spell in a few years. There is not a person of mature age but has known some such lamentable case; and there is no kindly-hearted man or woman but has many times shuddered in consequence at the awful danger dogging a pleasure which is so common and so harmless in its moderate use. It is like the ruin of the racecourse rising out of the innocent bets of the family card-table. Consequently large and increasing numbers of men and women would abolish the use of alcoholic stimulants altogether. Abstainers themselves, they would force others to abstain, and punish the moderate citizen of firm character in order to save the weak and unsuspecting members of society. From the hidden pitfalls described none who fall in ever escape whole, but those few who are saved from thence, and very few they be, are "saved so as by fire." At present society regards compulsory abstinence as an unwarrantable interference with private liberty. Compulsory vaccination is allowed, compulsory education is welcomed; but compulsory sobriety as yet is not acknowledged as a national need. The terrible evils of small-pox and of ignorance are so evident that they shock the national conscience, because of the vast numbers of the innocent who suffer through the carelessness of the guilty; but the evils of drunkenness are held to be confined largely to the individual drunkard, and the social reprobation of intoxication now rapidly growing up may, in the opinion of the majority, be trusted to keep the use of alcoholic stimulants within reason. On the other hand, even stating the case in the mildest way, the weakening of the drunkard's mental and bodily powers is not only transmitted to his enfeebled descendants, but prevents his doing his best work in the world, and destroys all comfort and peace in his family

relationships. The difference between the habits of the last generation and those of the present in this respect of the use of alcoholic drinks is enormous. Where once it was held almost an insult to the host to go to bed sober from a dinner party, it would certainly now be held the greatest insult possible to appear in the hostess's drawing-room in a state of intoxication. And the old plea of drunkenness to excuse violence, &c., now no longer serves; for our judges rightly hold it to be an aggravation of the offence, as it was a circumstance within the control of the offender.

Alcohol is one of the products of sugar-fermentation, and may be extracted from the rest of the fermented mass by distillation. A pound of sugar gives about half a pound of proof spirit (which has a specific gravity of 0·919), or about a quarter of a pound of absolute alcohol. Proof spirit is just half water (50·76 oz. of water to 49·24 oz. of absolute alcohol). But alcoholic stimulants are not solely made from actual sugar, though this and its congener, treacle, are large sources. Beet-root, maple, sugar-palm, and sweet fruits, especially the grape, are made available for the manufacture of alcoholic liquors. Yet all these sources together would be quite insufficient to meet the market; and, consequently, we descend upon the starches, close allies of the sugars, and convertible into them by fermentation; we use grain of all kinds, such as barley, wheat, oats, rye, rice, millet, &c., and in addition to these fresh starchy vegetables, especially the potato. A hundred ounces of starch mixed with 39 oz. of water will, when it receives a little over 6 oz. of diastase (ferment) made into a solution with 40 oz. of water, yield 87 oz. of sugar in one hour. This *wort*, as it is called. is then fermented by yeast or some other alcohol-producing ferment, and yields the desired alcoholic substance on distillation, the purest and best spirit being that which passes over first. A bushel of malt yields 2½ gallons of proof spirit in favourable circumstances.

Examining the action of the various alcoholic drinks in detail, by actual experiment, the following results are arrived at:—Pure alcohol produced by any of the means above detailed is, of course, not a usual alcoholic drink, but when taken by way of experiment in moderate doses (half an ounce in 2 oz. of water) at short intervals, it is found to increase vital action, quickening both the respiration and the pulse. Its whole effect is usually exhausted in 70 minutes.

Whisky is made from any kind of grain and starch-bearing vegetables, as potatoes and turnips; and its flavour is due to certain volatile oils which mingle with the alcohol as it passes over from the still. Old whisky, especially from the smaller stills, becomes mellow; but new whisky, such as that made in large quantities in the United States and retailed at a few pence a quart, is a fearful spirit, rough and fiery, rapidly engendering disease of the mucous membrane of the stomach, as well as of the liver, spleen, and kidneys. The Indians, whom it has hopelessly degraded and almost exterminated, have well named it "fire-water." It is noticeable that in mountainous regions, as in Scotland, or on the Swiss glaciers, whisky becomes palatable and desirable to those who in ordinary life dislike it. It is found, when its action is closely studied, to have an irregular or disturbing action upon the main vital functions. Respiration is stationary or falls, pulsation falls or rises, varying with varying experiments.

Brandy is, or should be, made by the distillation of wine; and 1000 gallons of wine yield 100 to 150 gallons of brandy at about proof. (But very little of what passes as brandy is made from this source. Cheap brandy is, as a rule, but flavoured potato-spirit. A certain "oil of Cognac" figures in its preparation.) True brandy is colourless as it distils, and is coloured afterwards to the fancy. Its fine flavour depends upon certain vinous ethers which pass over with the alcohol; and also on certain chemical products arising within itself after distillation, so that old brandy is wonderfully delicate and rich in bouquet. The effect of genuine brandy is found to be gently depressing, both on the rate of respiration and that of pulsation. The effect of ordinary made-up brandy is deeply depressing.

Gin differs in its composition with every large distiller—an average recipe being 80 gallons of coarse proof spirit to 10 gallons of water, 3½ lbs. of salt, a quarter of a pint of turpentine, some creosote and juniper essence. It contains no volatile oils of any moment. Such gin, direct from the distiller, is found to depress the vital energies alarmingly; the respiration diminishes by 56 cubic inches of air a minute. The common gin of the shops is far more harmful; for the retailer, to make it fiery and acrid enough for his customers, adds hot seeds, as coriander, carraway, capsicum, &c., and mixes in creosote, sulphuric acid, and salts of tartar.

Rum is (or at least it ought to be) distilled from fresh sugar-cane juice and sugar products, and it contains volatile and essential oils produced in distillation. If no fresh cane is used in its manufacture the spirit greatly suffers. It is colourless when distilled, and is coloured by burnt sugar (caramel). "Green" rum is very intoxicant and unhealthy, producing fever in hot countries and diseased liver in temperate climates; but old rum acquires vinous ethers in the course of aging, and becomes soft and of delicate flavour. It is, in fact, the most healthful of all the spirits, and *increases* both *respiration* and *pulsation* to about the same degree as pure alcohol.

Wine contains so much less alcohol than spirits of any kind that its effect is far less marked, but a long-continued series of experiments on various wines with doses of a large glassful each at one time was found to give, in almost every case, an increase of the great vital actions; whereas, if the aroma of these same wines were inhaled by a proper apparatus (but the wine itself not drunk), the inhalations lasting almost continuously over a full hour, the vital energies were uniformly lessened.

Beer is prepared in its best form from a decoction of malted barley, but like wine it is not distilled, though it has received full alcoholic fermentation. In both we drink the whole results of the changed liquor (speaking in round terms), and do not isolate the alcohol by distillation. Since the time of Henry VIII. beer has been flavoured and rendered more fit for keeping by the addition of hops, but this does not affect it as a stimulant. Beer differs from the foregoing stimulants in being undoubtedly a food as well as a stimulant; as the proverb goes, "Other nations eat their meat, the English drink it." Good beer is found under scientific tests to increase the vital functions considerably, the pulse is quickened after drinking it by four to seven beats a minute and an inch and a half more air is breathed at every breath. Hence in good beer we get an action very like, indeed, to that of good food; but not equal to the effect of bread or of milk. Light beer acts in the same way, but to a less extent. The beer of public-houses, however, is too often doctored most shamefully. Its quantity is increased by water, then its intoxicating strength is regained by adding tobacco or the seeds of *cocculus indicus*, whilst quassia restores the bitter and coriander and carraway seeds spice it. If the beer goes stale it is shaken up with green vitriol or with alum and salt to "revive" it. Thus added to the common danger of the alcoholic craving, the poor have to run the risks of harm from these deleterious substances.

To the above detailed sketch it must be added that the action upon the skin of all this class of stimulants, when taken above the most moderate quantity, is to dry it by checking the sensible (or moist) perspiration; and this action is the more marked according to the greater proportion of pure alcohols taken. No one ever found a drunken

man in a state of perspiration. As a result the blood is diverted towards the centres, and the great organs tend to become congested (occasionally this result may be of great medical service, of course). The inner surfaces suffer in the same way, so that the throat grows dry and the bowels become constipated. The muscles and all the tissues are relaxed by alcoholic stimulants, the face becomes stupid by the falling of the muscles of expression and the dimness of the eye, while the sluggish flow of the blood and congested state of the vessels is shown by the increased redness of the skin. The temporary paralysis of the brain is too obvious a symptom to need any notice; the senses die, the will is inert, speech is thick or ceases, walking is impossible, because the body is no longer balanced. The skin's dryness produces an oppressive feeling of heat upon the sufferer, and this is succeeded by a chilliness due to the falling of the temperature of the body which follows the momentary increase of the vital actions. The ultimate effects of drinking raw spirits closely resemble those of great cold; and the experience of Arctic voyagers, and of those who have served in winter campaigns or who live at great altitudes, shows how mortally dangerous the use of alcohol is under such conditions. The delusion of the ignorant that alcohol keeps up the weakly and warms the cold is without foundation. It is like a fire which makes a blaze for a brief instant, but leaves a cheerless waste behind. Any one engaged in arduous mental work knows, by experience, that even a single glass of wine incapacitates for severe study until its effect has ceased—that is, for about an hour. Speaking generally, all the effects accompanying drunkenness also accompany moderate drinking in duly diminished degree, of which any one may satisfy himself by observation. But what is so deleterious when aggravated may very possibly prove harmless when but slightly apparent.

Non-Alcoholic Stimulants.—Passing from these dangerous and unpleasant regions we come to the consideration of tea, coffee, and cocoa, "the cup that cheers but not inebriates."

Tea, which cost ten guineas the pound when we first began to use it in the sixteenth century, and which can now be had at twice or three that number of pence, has become practically a necessary of life in England. We should hardly know how to do without it. In common with the whole class of stimulants we are now treating of, tea, used moderately, seems to be wholly beneficial to the system—a great contrast to the class of alcoholic stimulants, whose pleasure is purchased at the cost of vital energy, even when they are sparingly used. Tea is found to quicken and deepen the respiration and to make it easy, at the same time to act but slightly on the pulse, and to act more powerfully on the skin, inducing free perspiration, and hence a deliciously refreshing coolness (an effect very remarkable in hot summer afternoons). This is not due to the effect of the hot water, for it occurs also when cold tea is drunk. Tea thus promotes the transformation of food without supplying nourishment, and, consequently, should not be taken pure without food; but the common practice of adding milk and sugar to it somewhat modifies this remark, since that addition certainly brings tea within the rank of foods of a certain small value. Tea has an excellent effect upon the mind, brightening and wakening it; and occasional doses of tea will usually keep a watcher awake during a whole night quite easily. At the same time it increases muscular activity, so that Professor Tyndall has recorded that cold tea was found by him to be the best possible liquid upon which to accomplish his arduous Alpine investigations. In both these particulars the action of tea presents a remarkable and favourable contrast to the stupefying and enervating effects of alcoholic liquors.

Coffee is very analogous to tea in its action; and in both the effective principle is believed to be an alkaloid which, though called caffeine in the one and theine in the other, is in reality identical. The caffeine may readily be produced by roasting coffee berries over a stove, having covered the vessel containing them with a sheet of glass. It will be deposited on the glass in a silvery film like hoar-frost—or if the heat be too quick in a dirty-yellow film—and the unaided eye will perceive the delicate transparent silky crystals of the alkaloid thus produced. Coffee differs from tea in rather increasing the rate than the depth of respiration; but still more in its opposite action on the skin, whose action it checks, and which it consequently dries. Hence the idea that coffee is a "heating" food; for directly the evaporation of the skin is checked more work is thrown upon the heart, and vessels tend to become congested. Coffee is an excitant of the nervous system, but less so than tea. It keeps one awake if taken late at night, probably because of its stimulating action on the heart, which it prevents from slackening its speed as is necessary during sleep. Less reactionary exhaustion follows an overdose of coffee than an overdose of tea. Finally, the usual addition of milk in considerable quantities makes coffee rather more of a food than tea. From the above remarks it is manifest that coffee is rather to be preferred to tea as a drink after a full meal; and at breakfast, and for poor people, coffee is in general found preferable.

Cocoa, and its flavoured form of chocolate, differ from tea and coffee in being thin gruels and not infusions of a leaf or a berry. Excepting the necessary removal of the large excess of "butter" contained in the *cacao* seeds, these are used in the form of very dilute paste or gruel, just as they are ground up. In consequence the food element enters much more largely into cocoa than into coffee or tea, especially when it is prepared with milk and not with water. It used to be the fashion to thicken cocoa with starch to neutralize the excess of fat; but improved methods of the extraction of the latter render this no longer necessary, and cocoa can be enjoyed as a thin drink. Cocoa also, like tea and coffee, contains an essential alkaloid called theobromine, closely allied to, but not identical with, theine and caffeine. Its action on the nervous system is far less than that of tea or coffee, but as far as it goes resembles them. It has little action upon the skin, but acts invigoratingly upon the respiratory processes, and slightly increases the pulse.

Coca-leaf (the coca-plant has no relation to the cacao) also contains in its infusion, largely drunk in Peru, an essential alkaloid, *cocaine*, akin to theine, &c. This particular alkaloid is, like the others, a poison when separated from its infusion (6 grains of pure theine will kill a cat, and we drink quite a grain in a large cup of moderately strong tea), and is of powerful medicinal value as a sort of solid local chloroform, completely depriving for the time any tissue to which it is applied of sensation.

Maté, another leaf-infusion, drunk in Paraguay, resembles tea in its stimulant action, but is far more bitter and astringent, containing more tannin in proportion to its theine than China tea.

Although, as just stated, the alkaloids which give their virtue to these non-alcoholic stimulants are poisonous when extracted and condensed, the infusions themselves must not be regarded as poisonous unless used in abnormal strength or quantity, such that the alkaloid is too plentiful to be quickly got rid of. Excess in any one of these innocent beverages will, however, lead to severe nervous and gastric disorganization.

STIMULANTS, or **EXCITANTS,** in medicine, are agents which increase vital action, first in the part to which they are applied, then of the system generally, and perhaps ultimately of some particular organ; and when this organ is a gland or secreting organ, a renewed or augmented secretion is observed. The nervous system is the part

which they chiefly influence, and through it the vascular, and in many cases the muscular. This is well seen in the simple effect following the employment of ammonia in a fainting fit, where the application of the vapour of ammonia, or its carbonate (smelling salts), to the nostrils, stimulates the brain, and so restores the heart's action, by which the circulation is resumed, and all parts dependent on it vivified. Aromatic vinegar, electricity, galvanism, and the sudden application of cold, have a like effect.

Stimulants are of two classes: one class comprises medicinal substances, such as alcohol, ammonia, ether, cardamoms, and red lavender; the other, warmth, cold, electricity, galvanism, and mental agents, such as music (when lively), joy, hope, revenge, &c.

STING, in botany, is a kind of hair with which many plants are furnished. It secretes a poisonous fluid, which, when introduced under the skin of animals, produces inflammation. Many plants are endowed with this kind of protection, the most common example of which is seen in the stinging nettles. In these plants the sting consists of a delicately elongated tube of cellular tissue, which is seated upon a gland formed of the same tissue. The poisonous fluid is secreted in this gland, which, when pressed, passes the fluid into the tube, just in the same manner as the venom passes up the fang of a serpent's tooth. See HAIRS OF PLANTS.

STING-RAY (Trygonidæ) is a family of cartilaginous fishes belonging to the group Batoidei or RAYS. The sting-rays have a long slender tail armed with a strong serrated spine, which is capable of inflicting very severe wounds. The spines are sometimes 8 or 9 inches long, and as they are barbed on the sides, the laceration produced by such a weapon leads to violent inflammation, and sometimes to gangrene, in the part affected. The severity of the wound inflicted is probably due in part to the inoculation of the spine with the mucus of the fish's body, which has some venomous properties. These spines generally replace the vertical fins, which are not developed. They are shed when worn out, and replaced by others growing behind them. The body forms a broad disc, with the pectoral fins uniting at the end of the snout. About forty species are known, chiefly from tropical and subtropical seas. The majority of the species belong to the genus Trygon. The Common Sting-ray (*Trygon pastinaca*) was well known to the ancients. It abounds in the Mediterranean, and is not uncommon on the southern coasts of Britain. It has been taken in the Frith of Forth. This species keeps on sandy ground at no great distance from land, and in summer wanders into shallow water, where it is often entangled in the fishermen's nets; this is the usual way in which it is caught, for it rarely swallows a bait. The manner in which this fish defends itself shows its consciousness of the formidable weapon it carries in its tail. When seized or terrified its habit is to twist its long, slender, and flexible tail round the object of its attack, and with its long arrow-shaped spine tear the surface, lacerating it in a manner calculated to produce violent inflammation. The flesh is coarse and unpalatable. When cut it is of a very bright red colour, suggesting the popular name *Fire-flaire.*

This species has a very wide range, extending from the Gulf of Mexico, through the Atlantic and Indian Oceans, to the shores of China and Japan. The other species of Trygon inhabit chiefly the tropical parts of the Atlantic and Indian Oceans, but some are found in fresh waters in eastern tropical America. One species of Sting-ray (*Urogymnus asperrimus*), common in the Indian Ocean, has no spine, but the body is densely covered with bony tubercles. Its skin is used for covering shields and the handles of swords.

STINK'STONE (Ger. *stinkstein*), a vernacular name applied to those limestones which are so charged with organic matter that, when struck, they emit the fetid odour of sulphuretted hydrogen.

STINK'WOOD (*Oreodaphne bullata*) is a tree of the natural family LAURINEÆ, indigenous to the Cape of Good Hope, and remarkable for the disagreeable odour of its wood, which is, however, hard and durable, and useful in shipbuilding.

STINT is a common name applied to several birds belonging to the group of SANDPIPERS (Totaninæ), and the genus Tringa. The Little Stint (*Tringa minuta*) breeds in the extreme north of Europe and Asia, and is an autumnal visitor to Britain, and also to Central and Southern Europe, Southern Asia, and North Africa. The little stint is nearly allied to the Dunlin (*Tringa alpina*), and is met with in the company of that bird and the sanderling on sandy shores, feeding on aquatic insects, worms, crustaceans, and molluscs. It is about 6 inches in length. The general colour of the plumage above is black, mixed with rusty-red; the under parts are white, and there is a broad bar across the wings of the same colour; the sides of the neck and a band in front of the neck are rusty-red speckled with black. Temminck's Stint (*Tringa temmincki*) is the smallest of the British sandpipers, measuring $5\frac{3}{4}$ inches in length. Its distribution is very similar to that of the little stint, but it is a rarer visitor to Britain. It also differs in its habits from that species, preferring the margins of rivers and fresh-water lakes. The general colour is brown above and white below. The American Stint (*Tringa minutilla*) breeds in the extreme north of North America, visiting the United States on migration. It has been taken on a few occasions in this country. The name stint is also given to the DUNLIN (*Tringa alpina*).

STIPEN'DIUM, whence our word *stipend* for a fixed salary not of the nature of wages, was the pension or pay of the Roman soldiers, first given them at the taking of Tarracina, B.C. 405. Before that time service in the army was a civil duty, like serving on a jury, &c., and was not paid. The word comes from *stips* (a donation) and *pendo* (I weigh out), because in early times money was weighed out and not counted. Two years afterwards a fixed stipendium or allowance was given to all the burgess-cavalry or *equites* for the maintenance of their horses and equipment. Prætorian cohorts received twice the stipendium of ordinary legionaries.

Certain cities under the dominion of the Roman republic paid yearly fixed *stipendia* instead of *vectigalia* (taxes ad valorem); and this was held a much more honourable tribute, besides being, in all probability, a lighter one.

STIP'ER-STONES FORMATION, in geology, a series of old rocks comprising, among others, the so-called "Stiper-stones" near Shelve, in Shropshire. These strata are more commonly known as the Arenig beds. See SILURIAN SYSTEM.

STIPPLE, a mode of shading by closely packed dots instead of by cross-hatching with lines. It gives a soft effect, but is wanting in severity and precision; consequently, for contours of flesh, for light and delicate shadows, &c., it is often of great service as a mixture with the pure line. The word comes from the Dutch *stippelen*, to speckle, dot all over; *stip*, Dutch for "point," is evidently allied to *stab*. In etching, the stipple is in fact done by stabbing the ground with a point all over the part to be shaded, and afterwards biting-in in the usual manner, instead of scratching through the ground in the orthodox way.

STIP'ULES, in botany, leaf-like appendages which are found at the base and on each side of the petioles of the leaves of plants, &c. They are frequently very like leaves, and present themselves in the various forms in which leaves are found; but are always to be distinguished from leaves by their position at the base of the leaf-stalk. They must

be regarded as belonging to the sheath of the leaf, which they replace in many plants. In *Lathyrus aphaca*, belonging to the same genus as the sweet pea, the stipules are large and leaf-like, the true leaves being reduced to tendrils. In the rose the stipules are present as well as the sheath, appearing as teeth at the top of that organ. Sometimes they are deciduous; sometimes *connate*, that is, united by their margins, forming in the Polygonaceæ a membranous tubular sheath (*ocrea*) round the petiole.

The function of the stipules generally is not very obvious, but in many cases there can be no doubt that they act as a protection to the young bud, as in Magnolia, and more particularly in the Tulip-tree (Liriodendron), where they embrace it in the form of two little valves. In compound leaves the leaflets are often furnished with smaller stipules.

STIR'LING, an inland county of Scotland, is bounded N. by Perthshire, N.E. by Clackmannanshire and a detached portion of Perthshire, E. and S.E. by Linlithgowshire, S. by Lanarkshire and a detached portion of Dumbartonshire, and S.W. and W. by Loch Lomond and Dumbartonshire. The greatest length, N.W. to S.E., is 42 miles; the greatest breadth, at right angles to the length, is 25 miles, but the average breadth is only about 10 miles. There are two insulated portions surrounded by Perthshire and Clackmannanshire. The area is 466 square miles. The population in 1881 was 112,443 (56,147 males and 56,296 females).

Surface and Geology.—The north-western extremity of the county is included in the district of the Highlands, and is occupied by the mountain range which forms the western prolongation of the Grampians, and separates Loch Lomond from Lochs Chon and Ard, which flow into the Forth. Of this range the principal summit is Ben Lomond, which has an elevation of 3192 feet above the level of the sea. The range consists of primary rocks, chiefly slates.

East of this district the face of the country becomes more level, and is occupied by rocks of the old red sandstone group; but in the central parts of the shire it again rises into heights, which form the group of the Lennox Hills, extending E.N.E. to W.N.W. from the Forth about Stirling to the Clyde near Dumbarton. They are estimated to attain 1500 feet in their highest part, and present many indications of volcanic origin. The Campsie Fells, which constitute part of the group and skirt the valley of the Kelvin, consist chiefly of large tabular masses of trap, the geological position and character of which vary considerably. That part of the county which skirts the Lennox Hills to the south and east, is included in the coal district of Central Scotland, and yields coal, ironstone, freestone, and limestone in considerable quantities. The carses or dales are generally occupied by the later formations or by alluvium.

Rivers.—The county belongs partly to the basin of the Forth and partly to that of the Clyde. The Duchray Water, one of the principal affluents of the former river, and which some regard as its principal source, takes its rise from several springs on the northern and eastern slopes of Ben Lomond, and forms for 5 or 6 miles the boundary of the county. It then enters Perthshire, but again touches the border of the county after its junction with the Forth. The latter afterwards forms the northern boundary of the county till it receives the Avon, when it takes an easterly course, and separates Stirlingshire from Clackmannan and Perthshire. The tributaries to the Forth in Stirlingshire are all small; the Bannockburn, the Carron, and the Avon are the principal. Some more important streams, such as the Teith, the Allan, and the Devon, join it on the opposite bank. Up to Stirling Bridge the Forth is navigable for small sailing vessels and steamboats. No part of the Clyde is in this county; but the Endrick and its feeder, the Blane Water, which drain the chief part of the district between the Highlands and the Lennox Hills; and the Kelvin, which drains the southern part of the county—are both affluents of that river. The Endrick does not indeed immediately join the Clyde, but falls into Loch Lomond, which communicates with it by means of the Leven Water.

Canals, Railways, and Manufactures.—The Great Canal, which connects the Forth and the Clyde, has part of its course in Stirlingshire. The manufactures of Glasgow are conveyed by this canal to the eastern parts of the island, and goods of various kinds taken back. The Edinburgh and Glasgow Union Canal commences near Edinburgh, and joins the Forth and Clyde Canal at Port Downie, near Falkirk.

Railways to Perth, Glasgow, Edinburgh, and other places intersect the county in various directions.

Manufactures of carpets, tartans, tweeds, winceys, blankets, and serges, shalloons, leather, chemical products, paper, and agricultural implements, are carried on; and there are also some large cotton mills, foundries, dye-works, and distilleries. The extensive ironworks of Carron have obtained a wide celebrity, and there are several coal-mines in both East and West Stirling.

Soil and Agriculture.—The hilly district of the centre and the Highland tract of the north-west, with the lower lands that lie between them, are in most places bleak and sterile; but the carse or valley of the Forth, extending 48 miles, and comprising 45,000 acres, from the neighbourhood of Falkirk to Stirling, consists of low and fertile alluvial lands. This carse was formerly covered with unproductive moss. On the removal of the moss soil, part of which was floated off into the Forth by the agency of running water, the present rich blue clay and sand of various depths was reached, and it has since been cultivated with marked success. The eastern side of the county presents a finely diversified appearance.

In the Highland district, with an area of above 76,000 acres, there are only about 1500 acres of arable land. There are above 4000 acres of natural woods or plantations, the latter being chiefly of oak and larch. The greater part of this district is waste land, used as a sheep-walk or pasture.

In proceeding from the Highland district towards the south-east the quantity of cultivable land increases. In the lower ground which separates the Highlands from the Lennox Hills, and in the straths or valleys of the Forth north of those hills, and of the Kelvin south of them, the quantity of arable land is greater in proportion. The hill sheep farms are very large.

The eastern part of the county, in an agricultural point of view, is by far the most important. There is here comparatively little waste land; the soil is almost wholly occupied in tillage or in plantations; and the greater facility for obtaining manure by means of the navigation of the Forth has greatly tended to the improvement of agriculture. They are generally well drained, and produce fine crops. Gardens and orchards are also numerous in this part of the county.

The shire returns one member to Parliament for the county, one for the Falkirk district of burghs, and one for the Stirling district.

History and Antiquities.—Stirlingshire was, at the most ancient historical period, included in the territory of the Damnonii, a tribe mentioned by Ptolemy. They were subdued by Agricola, A.D. 80, who formed a line of forts through their territory, reaching across the island from the Boderia Æstuarium, or Frith of Forth, to the Glotta or Clyde. This line of forts the Roman general Lollius Urbicus, in the reign of Antoninus Pius, about 140, connected by a continuous rampart of earth or turf. The rampart of Urbicus, or, as it is sometimes called from the emperor in whose reign it was constructed, the Wall of Antoninus (Antonini Vallum), commenced on the shore of

the Frith of Forth, a little to the east of Borrowstounness, and ran westward through Linlithgowshire, Stirlingshire, Lanarkshire, and Dumbartonshire, to the Clyde at Old Kilpatrick. It consisted of a comparatively slight rampart, with a deep ditch on the north side, and a military road accompanying it on the south side; the remains are popularly known as Graham's or Grime's Dyke, a name the origin of which is not ascertained. It is probable that some other antiquities should be referred to the Roman occupation, or to the period immediately before or after it. There are a few of the stone monuments commonly regarded as Druidical, earthen forts, cairns, and mounds or barrows.

In the Anglo-Saxon times Stirling became an important town, from its central situation, its strong fortress, and its commanding the passage over the Forth. Cambuskenneth Abbey, one of the richest and most important in Scotland, was founded in 1147 by David I., king of Scotland, for regular canons of St. Augustine, on a small peninsula on the north side of the Forth, a little below Stirling. Of this edifice some ruined walls and the belfry still exist.

From the time of the invasion of Scotland by Edward I. in 1296, down to the rebellion of 1745-46, Stirling Castle was a place of great consequence. The town was, in fact, the key to the Highlands, being the point at which the Forth first becomes fordable, and in consequence was the scene of many important events in Scottish history. In 1297 Wallace defeated a formidable English force near it, and in 1304 the town was taken by Edward I., after a three months' siege. The victory of Bruce at Bannockburn, 2 miles to the south, secured the independence of Scotland.

STIRLING, the county town of the above shire, and a royal burgh governed by a provost, four bailies, a treasurer, dean of guild, and fourteen councillors, is 435 miles N.N.W. from London by railway through Edinburgh, 36 miles W.N.W. of Edinburgh, and 29 miles N.E. of Glasgow. The town is situated on the south bank of the Forth, partly on an eminence, which, rising from the south-east, terminates on the north-west in a precipitous rock, 350 feet high, on which Stirling Castle stands, and partly on the lower ground to the north-east and south-east of this eminence. In the beauty of its site it rivals the Scottish metropolis, to which in some features it bears a resemblance. Like it, also, it no doubt owes much of its importance to the strong natural fortress of its Castle Hill. The lower portions of the town are comparatively modern; the upper parts are mostly ancient. The streets in the latter are narrow, winding, and in many places ill-paved, and contain several decayed houses; but some streets have been much improved in the present century and are lined with good shops. From its central position and easy communication by railway with all parts, the town is rapidly increasing in population and extent. The old church, a fine Gothic building, stands near the castle; it has a massive tower, 90 feet high, of Decorated English architecture at its west end. It was originally the conventual church of a Franciscan monastery, founded by James IV. in 1494. It has long been divided into two places of worship. In one of these Ebenezer Erskine, the founder of the Secession Church, officiated. James VI., when a child, was crowned in this church, the coronation sermon being preached by John Knox. The churchyard contains statues of Reformation heroes and other fine monuments. There are several other churches belonging to the Establishment, the Free Church, the United Presbyterians, Scottish Episcopalians, Roman Catholics, and other denominations of dissenters. There are a grammar and other endowed schools, and the town has long been noted for the superior character of the education imparted in them. The prospect which the Castle Hill commands is very fine. It embraces the whole of the beautiful and fertile carse or flat which lies along the banks of the Forth. Several counties can be seen, and no less than twelve battlefields. The castle presents a singular assemblage of buildings, some of them ancient, but altered and adapted to the purposes of modern warfare, although it is very doubtful whether they could oppose any effectual resistance to an army properly supplied with artillery. It is, however, stipulated in the articles of Union with England, that Stirling Castle shall always be garrisoned and kept in repair. The palace in the castle, built by James V., is now converted into a barrack; and the adjacent hall, built by James III. for the meeting of the Scottish Parliament, has been used for a riding school. Adjacent to this is the Chapel Royal, built by James III., and rebuilt by James VI. (I. of England), now employed as a store-room and armoury. South-west of the castle is the space formerly occupied by the king's park and garden; it is surrounded by an old wall, but is chiefly occupied as pasture or cultivated ground. In front of the castle, on a spot from which may be descried a portion of the battlefields of Stirling Bridge and Bannockburn, there was placed, in 1878, a fine memorial statue of King Robert the Bruce. James II. was born in Stirling Castle, and in it, in 1452, in a moment of uncontrollable passion, he murdered the Earl of Douglas, who had visited Stirling under the protection of a safe-conduct. Stirling was also the birthplace and residence of James V., who was crowned here. South of the church is Cowan's Hospital, built in 1639, a wealthy endowment for persons in reduced circumstances, now the Guild Hall, while the endowment is applied to outdoor pensions. The old bridge over the Forth is an inconvenient structure of stone, but a more convenient bridge has been built just below it, which commands a fine view of the town. The Smith Institute contains picture galleries, library, reading-room, and museum, where are kept the Stirling jug, the Linlithgow wheat firlot, and the standard bushel of 1821. The Stirling jug is a standard of the old Scotch pint which was intrusted to the keeping of the town by the Scottish Parliament. The firlot is said to have been given to Linlithgow, the ell to Edinburgh, the reel to Perth, and the pound to Lanark. The other chief buildings are the town buildings, formerly the athenæum, county buildings (1875), Macfarlane Library (1882), public halls (1883), and the trades hall. The gaol is a handsome building. There are commodious corn and meat markets and several banks. The manufactures are of tartan and tartan shawls, yarns, cotton goods, malt, leather, soap, and candles. There are dye-houses for yarns, home-made cloths, and silks, rope-yards, and breweries. The town, however, depends more on its general trade in corn, wood, coals, bricks, tiles, lime, and wool, than on its manufactures. There is constant communication by steam with Newhaven, near Edinburgh, and the intermediate places on the Forth. There is good railway accommodation to Edinburgh, Glasgow, Perth, Dunfermline, and through Fife; also with Balloch, Dunblane, Doune, and Callander. The population of the royal burgh in 1881 was 12,194; of the parish, 13,180. The parliamentary burgh has a population of 16,013. Stirling returns one member. At Abbey Craig, near Stirling, is the National Wallace Monument, which was completed in 1869. It consists of a Scottish baronial tower, 220 feet high and 36 square. The walls at the base are about 18 feet thick, and towards the top from 5 to 6 feet. In the monument are several large halls designed for the display of armour and other antiquarian relics illustrative of early Scottish history. A crown, upwards of 70 feet high, forms the apex of the monument. The structure is on the highest point of the Craig, which is about 300 feet above the level of the Frith of Forth, and overlooks the field of Stirling Bridge, where Wallace achieved his greatest victory.

STIRRUP-CUP, a parting drink given to travellers in olden times when they were on the point of depart-

ing, and their foot was in the stirrup. Thus, in Scott's "Marmion" (i. 31)—

> "Lord Marmion's bugles blew to horse,
> Then came the stirrup-cup in course;
> Between the baron and his host
> No point of courtesy was lost."

It was while drinking such a stirrup-cup that Edward, king and martyr, was killed by his stepmother, Ælfthryth, at Corfe Castle.

STITCH, in the side (technically *Pleurodynia*), an apt and expressive name, commonly employed to describe a sharp catching pain in the side, which is sometimes produced by taking exercise immediately upon a hearty meal, by running, or immoderate laughing, coughing, and sneezing. Delicate women are very liable to this affection, and it is not uncommon among men who have passed through an exhausting illness. It is always increased by taking a deep breath, or by any movement which puts a strain upon the muscles. Some forms of this affection may be relieved by stooping, a circumstance which accounts for the success of the vulgar remedy of making a cross on the foot with the finger. If the pain is of longer duration relief may be obtained by the use of a mustard plaster, and where the pain persists a stout plaster worn over the seat of the pain may be of service. In some cases two or three plasters applied, one over the other, may be necessary to effect a cure. In pleurisy a pain is felt in a small spot on a level with, or just beneath the breast on the affected side. It occurs at each full inspiration, and may be likened to the feeling produced by a sudden puncture from some sharp instrument. Before the introduction of the clinical thermometer the pain caused by pleurodynia was often mistaken for the pain of pleurisy, but now, in the majority of cases, an examination of the temperature will speedily enable a medical practitioner to distinguish between the two.

STITCH'WORT. See STELLARIA.

STI'VER (properly *Stuiver*), the Dutch penny, almost exactly equal to our own coin; it is the twentieth part of a *guilder*, the Dutch florin, value 19·983 pence, or within ·017 of a penny of twenty pence. The *stuiver* is therefore less than the English penny by the small fraction of ·00085.

Another *stuiver*, that of the old Dutch coinage of the Cape of Good Hope (which was formerly one of the main colonial possessions of Holland, and where many remains of the Dutch occupation still linger), is the sixth part of the Dutch *schilling*, and worth, therefore, within a small fraction, just three-eighths of an English penny.

The word in its English dress has become proverbial—"not a doit, not a stiver," answers the angry father in the novel, unconsciously naming two Dutch coins in his emphatic refusal to give. (The *doit* is the eighth part of a stiver.) Etymologically, the word stiver or stuiver appears to be akin to the high German *staub*, dust, and to mean therefore a small fractional part.

STOAT. See ERMINE.

STOBAI'OS, JOANNES (Lat. *Stobæus*), a learned Greek, probably of the fifth century, a native of Stobi in Macedonia; hence his surname. Nothing is known of Stobaios except that he was a learned and laborious compiler of extracts from early Greek writers, chiefly philosophers and poets, many of whose works, but for him, would have been altogether lost. These extracts are digested under heads—"Concerning Virtue," "Concerning Prudence," "Concerning Intemperance," &c. The most complete edition of Stobaios is that which was published at Geneva in folio (1609). In 1822 Gaisford put forth a much improved edition of the "Anthology."

STOCK, in financial transactions, represents an imaginary sum invested in a certain fund, usually £100, upon which a certain rate of interest has been promised. The holder of stock can sell it or any part of it, and what the purchaser buys is really the right to receive a certain amount of interest in perpetuity. The principal sum is invariably imaginary. Of this class of funds the consols, the three per cents, other government funds, railway and gas stocks, &c., are examples. One peculiarity about stocks is their easy divisibility. Consols may be bought for any amount not involving fractions of a penny; railway stocks for any amount not involving fractions of a shilling, which renders stocks more convenient in many cases than bonds, debentures, or shares, which all go in fixed sums. The phrase a "long stocking," or an "old stocking," as applied to a hoard of money, refers to the long stocking or putting-by into a stock of small sums during a long interval, and by no means to an assumed use of a stocking as a receptacle for money, which, in fact, was never customary. It is one of the numerous instances of unwarranted FOLK-ETYMOLOGY.

The derivation of *stock* in its financial sense has sometimes puzzled etymologists, who have even gone to the desperate length of regarding stocks as "money set as fast in the funds" as stocks are in the earth. (Trench on the "Study of Words.") The true origin is, however, quite simple. When reading and writing "came by nature," in Dogberry's time, payments into the exchequer were made by tally. In the museum of the customs are many tallies. These were wooden laths across which notches were cut according to the number of pounds or shillings paid; then the *tally* (Fr. *taillé*, cut-off) was rent off by splitting down the middle and given as a visible receipt and proof of payment, while the *stock* remained in the custody of the office. In case of any dispute the tally and stock could be brought together and the notches would coincide; whence our word "to tally" in the sense of exact correspondence. So also when money was lent to the government it was accounted for by stock and tally (or stock and counter-stock), and was spoken of as money held in the government stocks. The term was convenient and soon spread to other funds which were like the government stocks, saleable though irredeemable.

STOCK EXCHANGE, a place or building where stocks and shares are bought and sold. In England the term stock is confined to government loans, annuities, bonds, railway capital, and such other forms of capital as are raised in sums of money, all of which is paid up, shares being generally smaller divisions of capital, the amount of which is paid up by instalments, and in which a part may, by arrangement, be left unpaid, but for which the holder is liable. In the United States bonds representing national, state, county, and city debts, and the shares of railways, banks, and mining, manufacturing, telegraph, and insurance companies, are all called stocks. In France the word *rentes* has the same limitation as stocks in England. Dealing in stocks, bonds, shares, &c., is the business of the stock exchanges, and the dealers in them are known as stockbrokers and stockjobbers. The chief institution of this kind in Great Britain is the London Stock Exchange, perhaps the most important financial centre of the world. The first recorded dealings in securities appear to have taken place about 1694, after the first charter had been granted to the Bank of England giving it the privilege of dealing in bills of exchange and buying and selling of bullion, &c., and after capital stock could be transferred. The dealings were at first extensively carried on within the walls of the bank itself; but about the beginning of the eighteenth century the amount of business had so increased that it became necessary to arrange for another place of meeting. The dealers accordingly adjourned to Change Alley, which they continued to frequent for a long period. The chief centre of business there was Jonathan's coffee-house, and the term *alley* was until within a recent period familiarly used as a cant phrase for the Stock Exchange, "dabbling in the Alley" signifying speculating there. In 1773 a room was engaged in Sweeting's Alley, which was

called the Stock Exchange, and where any one might transact business on payment of a fee of 6*d*. At the beginning of the present century the greatly increasing business became too much for the rooms, and the indiscriminate admission of the public was calculated to expose the dealers to the loss of valuable property. Accordingly a number of them formed themselves into a company, and having acquired a site at the end of Capel Court, they erected a new and spacious building for the special purpose of dealing in public securities. After the erection of the new building free admission ceased, and no one was allowed to enter except subscribers, who were elected annually by ballot. Since that period the institution has annually increased in its extent and importance, and at the present day a building three or four times as large as the original structure affords shelter to over 2500 members, divided almost equally into brokers and jobbers, or dealers. The objects professed by the Stock Exchange are to provide a ready market for all approved securities, and to make such regulations as will insure the prompt and regular adjustment of all contracts. The administration of the Stock Exchange is in the hands of two bodies with distinct functions, *i.e.* the managers and the committee. The former represent the shareholders, the capital being represented by 4000 shares besides debentures, and they form the executive of the proprietors of the building, but they have no control over the business transacted by the members. All matters connected with the business carried on are in the hands of the committee for general purposes, who represent the subscribers or members, and who are annually elected. All members are also elected annually, their subscriptions being paid to the managers. By the rules of the Exchange a candidate for election must be a British subject, and previous to his being balloted for must be recommended by three members of not less than four years standing, who have fulfilled all their engagements, and who are not indemnified. Each of these recommenders must also become surety for the applicant to the extent of £500 to the creditors in case the applicant is declared a defaulter within four years from the date of his admission. If the applicant has been a clerk in the Stock Exchange for four years previous to his application he requires two sureties only for £300 each. Applicants of the former class pay an entrance fee of £105 and an annual subscription of £22 1*s*., while those of the latter pay an entrance fee of £63 and a subscription of £22 1*s*. The number of members, as previously mentioned, is now over 2500; many of them, however, act only as clerks to other members, and are not permitted to engage while thus employed in any business on their own account.

In reference to the two classes of members, it is tl business of the brokers to receive and execute the orders of merchants, bankers, capitalists, and private individuals, f which they are paid by commission. There is no official tariff for commissions on the London Stock Exchange, the amount charged being regulated by custom, or arranged by a mutual agreement between brokers and their principal: There is nothing to prevent brokers dealing with one another, and indeed such dealings are of constant occurrence, but the majority of the transactions are arranged by dealings with the jobbers. The latter are men possessed of more or less capital, who have a connection among the brokers, and who devote their attention to a particular class of securities. It is their business to make themsel acquainted with the market value of the stocks they deal in, and to be always prepared to "make a price" at whicl they will buy or sell to the brokers whenever the latter present themselves. A jobber's price is thus a double one as, for instance, when he quotes consols as "par to ar eighth," meaning that he will buy at 100 or sell a 108⅛, the difference of 2*s*. 6*d*. per cent. representing his "turn" on the transaction. The amount of the turn, like the commission of the broker, is regulated by custom or the exigencies of business, and it varies from a few pence in the case of low-priced mining shares up to 2 or 3 per cent. in high-priced or "out-of-the-way" stocks, or such prices as are made during the excitement of a panic. Members are required to define the capacity in which they deal, and though a broker may turn jobber, or *vice versa*, with certain slight exceptions no member or firm of members may carry on both descriptions of business at the same time. All disputes between members that cannot be arranged by arbitration are settled by the committee, the decision of the latter being final and subject to no appeal. No member is allowed to institute legal proceedings against another member without first obtaining the sanction of the committee. Disputes in relation to the business of the Exchange between members and non-members may also be settled by the committee if the latter make request and consent to abide by the decision given. Minor offences are punished by public censure or suspension, serious offences being visited with the heavy penalty of expulsion. Members who are unable to fulfil their engagements, and who do not declare themselves, are publicly declared defaulters by direction of the chairman, deputy-chairman, or any two members of the committee. The announcement is made simultaneously in each of the large divisions of the building by two of the senior waiters, the public statement being preceded by three strokes with a mallet. After the ceremony of "hammering," a defaulter is debarred from entering the Exchange, and he only becomes eligible for re-admission when he has paid at least one-third of the loss caused by his failure, independently of any security money, or when he has recouped the sureties one-third of the amount paid by them when the debts have been less than the amount secured. Re-admission is entirely in the hands of the committee for general purposes, who inquire into all the circumstances of each case, and any member who objects to a re-admission is allowed to represent his views before the committee. The names of defaulters were formerly kept from the public, but they are now officially communicated to the daily papers. The constitution and management of the Stock Exchange were in 1876 made the subject of inquiry by a royal commission, which presented its report in 1878, and which was upon the whole highly favourable to the institution. The commission had been appointed during a period of strong irritation caused by the flagrant defalcations of certain foreign states and the unmitigated rascality of certain promoters of foreign loans; but it was proved that the latter class consisted of persons quite outside the "house," who used the Exchange as a market for their securities. In the latter operation they had been assisted by certain unprincipled members; but it was shown that such practices received no encouragement from the rules, and most of the arrangements of the Exchange were left by the commission to stand as they were. The rules of the Stock Exchange are published by the secretary to the committee with their authority, and may be obtained for a small sum on application. Lists of the members, with their private and business addresses, and the names of their bankers, may also be obtained in a similar way. It may be also mentioned here that *no member of the Stock Exchange is ever allowed to advertise*, or even to issue circulars to others than his own clients, and hence those persons who advertise themselves as "sworn brokers," "dealers," "stock and share brokers," &c., are in no case connected with the Stock Exchange.

It is impossible to offer any estimate of the amount of business transacted by the London Stock Exchange, but could the figures be presented they would prove to be of a stupendous character. In the ordinary way the bargains are made by quiet conversation between the members, all bargains being made by word of mouth, but in times of

excitement the dealing requires an amount of wild shouting and gesticulation that would be startling to outsiders if any were admitted.

In the conduct of its business the Stock Exchange employs a number of peculiar terms not generally understood by outsiders, and many of the securities dealt in acquire in the process a special name which quite takes the place of the official designation in ordinary transactions. The technical terms in most frequent use are "bull" and "bear," designating respectively those who operate for the rise or fall in the price of stocks, a bull being a buyer who hopes to sell at a profit, and a bear a seller who hopes to buy back what he has sold at a lower price. The bull endeavours to elevate or "toss up" the price, while it is the aim of the bear to lower or pull it down. Other terms in common use are "option," a term which signifies the right of dealing at a given price within a certain fixed time, the privilege of selling being further known as a "put," and that of buying as a "call." "Contango" is the name given to the rate of interest, or sum paid by a buyer for the privilege of deferring payment for the stock bought from one account to another, such stock being described as "carried over," while the term "backwardation" or "back" is given to such sums as are paid by sellers for a similar postponement of the delivery. A "corner" signifies a combination of speculators for the purpose of forcing up the price of any stock, but the use of this term is not now restricted to the Stock Exchange. A member who seeks to depress a price by offering to sell large amounts of stock is significantly described as a "banger," a "puffer" being one who bids for stock that he does not want, with the view of raising the price. The terms "waddle," used to designate defaulting, and "a lame duck," as applied to a defaulter, once very common, are now but little used.

Most of the large towns of Great Britain have now Stock Exchanges of their own, the rules of which are generally based to some extent upon those of the London institution. On the Continent the Stock Exchanges of Paris, Berlin, Vienna, Frankfurt, and Amsterdam are the most celebrated, while the New York Stock Exchange is said to rival that of London in the amount of business transacted. As might be expected a vast trade is carried on between these different financial centres, and this, known technically as "arbitrage," grows every year in extent and importance.

STOCK or **STOCK GILLIFLOWER** is the English name for species of the genus Matthiola, belonging to the order Cruciferæ. The species are mostly herbaceous plants, inhabiting the warm countries washed by the Mediterranean. Many of the species of this genus are great favourites in gardens, on account of their handsome flowers and fragrant smell. *Matthiola incana*, a doubtful British plant, found only on the cliffs in the Isle of Wight, is the origin of the garden varieties of Brompton Stock, which have hoary leaves. The Sea Stock (*Matthiola Sinuata*) is rare on the coasts of Cornwall and Wales. The garden varieties known as Ten-week Stock are derived from *Matthiola annua;* and the annual stocks with smooth leaves from *Matthiola græca.* In order to raise the more valued kinds, as the Double-stock Gilliflower, the Brompton Stock, and Queen's Stock, the seed should be saved from plants growing among double flowers, as it has been proved that such seed produces more plants with double flowers than the seed obtained from double-flowering plants. The Virginian Stock (*Malcolmia maritima*) belongs to a nearly allied genus. It is a native of the Mediterranean coast, but is successfully and generally cultivated in Great Britain.

STOCKADE, in fortification, is the name given to a wall constructed by planting upright in the ground squared trunks of trees, or rough piles of timber, so as to inclose an area which is to be defended. The trunks or piles are planted close together; and at intervals of 3 feet from one another loop-holes are cut through them, or notches a few inches long are cut down, vertically, from the top, through which the defenders may direct a fire of musketry on the assailants.

Stockades are still frequently constructed as temporary fortifications in countries which abound with timber, as in North America and the East Indies; and among uncivilized nations, these and rude parapets of earth are the only kinds of fortifications which have been executed. On the frontiers of the United States of North America, during a war, stockades consisting of roughly-hewn trunks of trees planted close together in upright positions and pierced with loopholes for musketry, were very frequently constructed during the time of the first settlement of that country. At each of the angles of the inclosure there was formed a sort of blockhouse, consisting of very thick logs of timber placed horizontally; it had a lower and an upper storey, the angles of the latter projecting over the sides of the former.

STOCK-FISH, a commercial term for salted and dried fish, such as cod, ling, hake, haddock, and torsk. As soon as the fish is brought on shore it is split up from head to tail, cleansed abundantly in salt water, and a piece of the backbone being removed, is well drained of superfluous moisture, laid in a long vat or barrel, salted, pressed, and covered by heavy weights. It is afterwards taken out, washed, brushed, and exposed to sun and wind. As soon as it assumes a certain whitish efflorescent appearance, technically called "bloom," it is ready for the market. In Scotland upwards of 100,000 cwts. of stock-fish are cured annually for home consumption and exportation, and in Canada and Newfoundland the preparation of stock-fish forms a most important industry.

STOCK'HOLM, the capital of Sweden, is situated on the channel by which the Lake Mälar discharges its waters into the Baltic. The distance from the sea by this channel is 36 miles. The mean temperature of the year is 43°; in winter 26°, and in summer 60° Fahr.

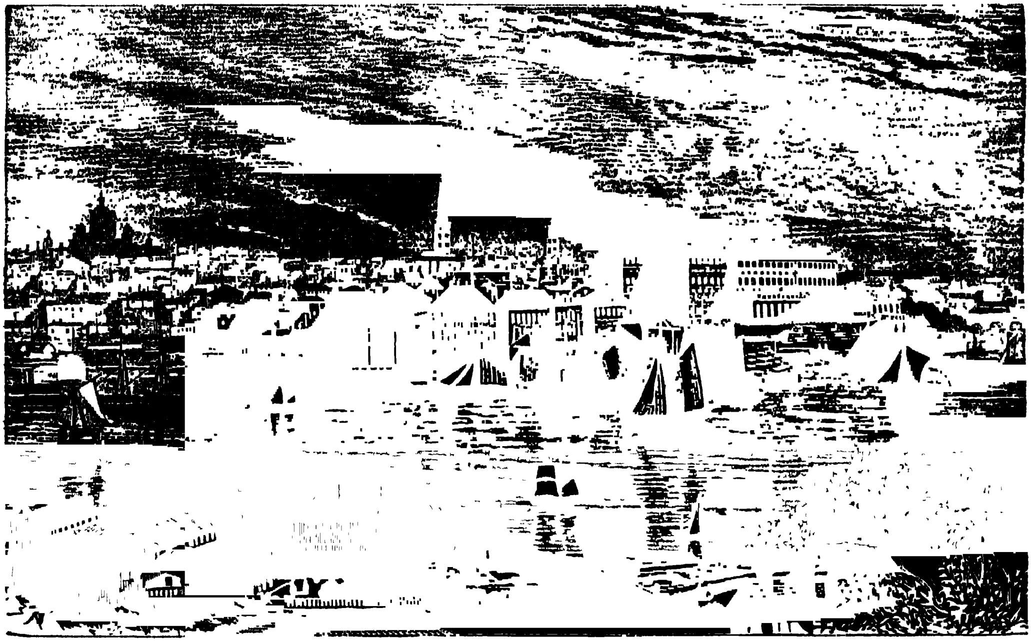
The city of Stockholm is built partly on the continent and partly on the nine islands formed by the above-mentioned channel; the islands are called *Holmen.* In the middle of the channel is the island of Stockholm, or "island of the castle," also called Staden, because the town was originally first built on it, and Riddarholm (the "island of the knights"). South of these lies the large island of Sodermalm, at the western extremity of which are Langholm and Rakningholm. North of the channel a large portion of the town is built on the mainland and called Norrmalm. With this are united the island of Kongsholm (King's Island), which lies west of it, and those of Blasiiholm, Skeppsholm (Ship Island), and Kastellholm, to the east of Norrmalm. The climate of Stockholm is unhealthy, owing to the marshy land which surrounds it; and in all parts of the city it has been necessary, from the nature of the ground, to build upon piles. Much of the oldest portion is a labyrinth of narrow crooked streets, but the more recent parts contain straight and wide streets, capacious squares, and well-built stone houses.

The island of Staden, or Stockholm, occupies the centre of the town, and contains several fine public and private buildings. The royal palace, an edifice of great architectural merit, built in 1758, stands on an eminence, and is surrounded by a large garden. Besides the apartments in which the royal family reside, it contains a library, in which a copy of every book printed in Sweden must be deposited, a picture gallery, collections of paintings, coins, and antiquities. Before the extensive court-yard of the palace, and near the banks of the channel, is the colossal bronze statue of Gustavus III.; and in its vicinity, along the eastern shore of the island, is the proper harbour of

the town, in which the largest vessels find excellent anchorage. Further to the west is the cathedral, or St. Nicolai Church, also called Storkyrkan, or head church—an imposing edifice, with paintings and statuary, in which the kings of Sweden are now crowned; and at some distance from it the Masonic Temple, with a bronze statue of Gustavus Vasa in front. From the square a handsome stone bridge—forming the most fashionable lounge in Stockholm—leads to the Riddarholm, which is much smaller than the city, but contains several large public buildings; among them being the old palace and the old church of Riddarholmen, where the kings and distinguished persons born in Sweden are buried.

Sodermalm, or the southern division of Stockholm, is built on the island of the same name, which is about 3 miles long and nearly 2 miles across in the widest part; it is joined to the city by a long bridge, and provided with a large lock on account of the great rapidity with which Lake Mälar sometimes discharges its waters. The surface of the island is rocky and very broken; and though there are many fine buildings near the channel, the interior of this section of the town is mostly composed of small wooden houses situated between rocks and swamps, and of gardens and corn-fields. In the Sodermalm is the great depot of iron, whence it is shipped to all quarters of the globe. The most remarkable of the buildings here are—the town-hall, the Danviken or Great Hospital, and the Maria Magdalene and St. Catharine churches. The island of Langholm, which is further west, and is connected with the Sodermalm by a bridge, contains the houses of correction; and on Rakningholm, which likewise is joined to Sodermalm by a bridge, there is a park.

The Norrmalm, or northern division of the town, occupies a gentle slope, which gradually rises about 200 feet above the sea-level. It is much better built than the Sodermalm, and has several fine squares and streets, among which King Street is distinguished by many good buildings. A well built bridge connects it with Stockholm. On the finest of the squares, called that of Gustavus Adolphus, stands the bronze equestrian statue of that great king. One of the sides of the square is occupied by the opera-house, a fine large edifice, where Gustavus III. was assassinated in 1792, and in which Jenny Lind achieved her first triumph. Not far from the square is the King's Garden (Kongs Tregorden), a public promenade, in which a statue of Charles XIII. has been erected. Among the churches of this part of Stockholm, that of Adolphus Frederick is distinguished by its beauty. At the northern extremity of Norrmalm is the observatory, which is well provided with astronomical instruments and a library; and adjoining it lies the botanical garden. The island of Kongsholm, to the west of Norrmalm, is joined to it by two bridges. It is not much built on, but contains the great iron foundry established by an Englishman, a large hospital, the Bible printing-office, and the royal cannon foundry of Marieberg. Contiguous to the Norrmalm on the east is Ladugärdslandet, on which were formerly some royal farms.



Stockholm.

A part of it has, however, been built upon; while another part has been converted into a royal park, called Humlegärd (hop garden), to which the public have access. The island of Blasiiholm, which has been converted into a peninsula by filling up the channel that divided it from the continent, is north-east of Stockholm and south-east of Norrmalm, of which it now constitutes a portion. It contains some fine buildings. Contiguous to it, and only separated by a narrow stream, over which there is a bridge, is the small island of Kyrkholm. From thence a long wooden bridge crosses to Skeppsholm, where the flotilla of the skära is stationed. Another wooden bridge leads to Kastellholm, a very elevated island, planted with fine trees; a castle has been built here for the defence of the entrance of the harbour. The environs of Stockholm are rendered very beautiful by the islands, the channels between them, the country houses, and the gardens; in fact it is one of the most picturesque and handsome capitals

in the world. Few cities can boast of finer promenades, the most frequented being the Djurgård, or deer park—remarkable for its picturesque beauties and its magnificent trees and drives—which is unquestionably one of the finest public parks in Europe; the Ladugard's Gård, or review ground; the Haga park; the beautiful cemetery adjoining; and the park of Carlberg, finely planted and connected with the city by a long and beautiful avenue.

Stockholm is the seat of the government of Sweden, and consequently it contains the hall of the Diet, the offices of all the branches of administration, and the superior courts of justice. There are several scientific and literary societies, among which the Royal Society of Sciences has greatly contributed to the advancement of natural philosophy, chemistry, and natural history; also a Royal Academy of Literature, History, and Antiquities; the Swedish Academy, whose object is to promote the cultivation of the native language; an academy of military sciences, an academy of liberal arts, a musical academy, and an academy of agriculture. The charitable institutions are very numerous, and in this respect Stockholm is superior to any other city in Europe of equal size. The establishments for education are also abundant.

The population of Stockholm in 1880 was 168,775. It is the most industrious and commercial town of Sweden, the principal articles manufactured being cloth, cotton, calico, glass, porcelain, silk, ribbons, sugar, tobacco, leather, cast iron, steel, steam-engines, and soap. Nearly the whole of the superfluous produce of all the countries north and west of Stockholm is brought here to be exported to foreign countries. The value of the iron exported is as great or greater than the total amount of the other exports, the chief of which are—timber, deal planks, tar, pitch, copper, steel, cobalt, bricks, and a few manufactures. The most important articles of import are—sugar, coffee, wine and brandy, rum, woollen and cotton manufactured goods, silk, linens, china and earthenware. hemp, cotton, cheese, potash, hides and skins, tallow and candles, train-oil, dyeing woods, raisins, almonds, pepper, cinnamon and cassia, tea, butter, and wool. The port is very favourably situated for trade, and can accommodate a large fleet. Several hundred ships can lie alongside the quays. The channel by which it is reached from the Baltic has in no part between the outer lighthouses and the quays a less depth than 22 feet. Above the town lies the great Mälar Lake, which runs inland 100 miles, with safe navigation for vessels drawing 12 feet of water. The harbour is generally closed by ice from December to March. The strong fortress of Waxholm effectually commands the passage to the city, as all ships must pass within range of its guns. In addition to its foreign commerce a very extensive inland trade is carried on. There is railway communication between Stockholm, Gottenburg, Malmo, and Christiania.

Stockholm was founded about 1260 by Birger Jarl. It was fortified at an early period, and stood several sieges. One of the most memorable of these was in 1501, when it was defended against the Swedes, for the crown of Denmark, by the Danish Queen Christina; another still more memorable was in 1520, when an equally heroic female, Christina Gyllenstierna, widow of Sten Sture, held it for the Swedes against the perfidious and sanguinary Christian II. The capitulation made was shamefully violated by the king, who, after pledging himself to respect the rights of the inhabitants, was guilty of the most atrocious massacres. The indignation which was thus produced in all quarters of the country paved the way for the war of liberation, which, conducted by Gustavus Vasa, at length terminated gloriously, by the expulsion of the Danes, and the establishment of Sweden as an independent kingdom.

STOCKINGS AND STOCKING-FRAME. The term stocking is now used to signify a close-fitting garment for the foot and leg, usually knit or woven. From paintings found at Pompeii and sundry notices in the Latin classics, it appears that stockings were known to the Romans in the later days of the republic and under the empire, but they formed no part of the ordinary costume. Fascial bandages wound round the leg from the ankle to the knee were sometimes worn by persons in delicate health, or as a protection to the legs in hunting, marching, &c., but their use was restricted, as a rule, to such occasions. In England the earliest coverings for the legs were made of cloth or leather, the material being cut to shape and sewn up. These coverings were termed hose, and the name stocking was not introduced until the sixteenth century, when it was applied to the continuations of the trunk-hose or breeches then worn. Knitted stockings are said to have been first made in Scotland in the early part of the sixteenth century. About the middle of that century knit silk stockings were introduced from Spain, into which country the art had been introduced by the Moors. In the time of Elizabeth the knitting of stockings was an important industry in England, and when, in 1589, the Rev. William Lee, of Woodbridge, Nottinghamshire, designed his stocking-frame the queen refused to grant him letters patent, on the ground that machine-made goods would drive the hand-made out of the market and ruin the workpeople. Failing to secure protection in England, Lee took his machine to France, where he was favourably received by Henry IV., and permitted to establish a factory at Rouen, in which he employed a number of his own countrymen. After the death of his royal patron, however, Lee shared in the persecution to which Protestants were subjected, and driven out of Rouen, he died in Paris in 1610. His brother and some of his workpeople introduced the manufacture into Nottinghamshire, which has ever since been famous for its production of stockings. The machines now in use, however, are far more ingenious affairs than Lee's invention, though founded on the same principle. The machine designed by Lee was a square frame, producing a straight strip of material, which was cut off in proper lengths and seamed together to form the stocking; but a great improvement upon this, the origin of which is unknown, was the circular loom, in which a continuous circular web is knit of any length, which is cut up and formed into the shape of a stocking. With respect to the principle of these machines it may be observed that in knitting, as the reader is probably aware, only one thread is used, which is formed into a succession of loops on the wire or needle, and through each of these loops another loop is drawn by means of another wire or needle, a similar series of operations being performed until the stocking is completed. Now, in the frame there are as many needles as there are loops in the breadth of the web to be woven, and these are so made as to alternately form and throw off the loops. One end of the needle terminates in a hook, the other is fixed into a small casing of tin, so as to fit into a frame side by side with its companions. Between the needles thin plates of lead or pewter, called sinkers, are placed in two rows; in one row they move freely on an axis; in the other they are attached to a bar, and move with it. The object of the former, or jack-sinkers, is by pressing the thread down between the needles to form loops, while the latter, or lead-sinkers, press simultaneously on the hooks of the needles in such wise that while they pass through the loops without catching they take them up when their hooks are opened, and they are raised in the contrary direction. The regularity of these movements is insured by various ingenious contrivances, which can only be understood by ocular observation of the machine when at work and the *vivâ voce* description of an intelligent workman. See WEAVING.

STOCK'MAR, CHRISTIAN FRIEDRICH, BARON VON, a celebrated diplomatist, was born in Coburg 22nd August, 1787. He was educated for the medical

profession, and practised first in Coburg, and in 1814–15 in the army. In 1816 he became physician to Prince Leopold, and soon afterwards his private secretary, becoming comptroller of his household till after his accession, in 1831, to the Belgian throne. A man of elevated character, he possessed a wide knowledge of affairs, which, added to his great tact and sagacity, led to his being frequently employed on important diplomatic missions. Among these the more important were those connected with the marriage of Prince Ferdinand of Coburg with Queen Maria II. of Portugal (1836), and the marriage of the Crown Prince of Prussia with the Princess Victoria of England (1858). He was the trusted friend and counsellor of the Coburg family, and was also on terms of intimate friendship with Prince Albert and Queen Victoria, to whom he made for many years a prolonged annual visit. Ennobled in 1821, he was made Freiherr of Bavaria in 1831. He died at Coburg on 9th July, 1863. See Theodore Martin's "Life of the late Prince Consort," vols. i. and ii.; "Denkwürdigkeiten aus den Papieren des Freiherrn Christian Friedrich von Stockmar," by Ernst von Stockmar (Brunswick, 1872), or the English translation edited by Max Müller, "Memoirs of Baron Stockmar" (London, 1873).

STOCKPORT, a municipal and parliamentary borough, partly in Lancashire, but chiefly in Cheshire, 182¼ miles N.W. by N. from London, and 6½ miles S. by E. from Manchester by railway, stands at the junction of the rivers Tame and Mersey, and consists of a number of streets irregularly laid out, with a large open market-place in the centre. The town is well paved, and the principal part of it built of brick on steep and irregular hills of soft red sandstone, rising in some places precipitously from the banks of the Mersey, and around which the houses are erected in successive tiers. The situation of Stockport gives it at all times a picturesque appearance; and at night, when the factories are lighted up, the view is striking in the extreme. There are numerous bridges connecting the town and its suburbs, including a handsome modern structure of eleven arches, leading to the newer parts of the town. There is also an imposing railway viaduct of twenty-seven arches, 111 feet in height and 1780 long, overlooking the houses. The parish church is for the most part modern, having been rebuilt early in the present century, in the Perpendicular style of architecture. It has a tower with pinnacles and pierced battlements. There are several other places of worship of the Establishment, besides a number of chapels for different classes of dissenters. At the free grammar-school (founded in 148 by the Goldsmith's Company of London, and rebuilt some years ago) instruction in the ordinary branches of education is given gratis to 150 boys, sons of the inhabitants of the borough. The other public buildings include an infirmary, which is a very ornamental structure; a small theatre; a town-hall; the Union club; banks, &c. The town also contains one of the largest Sunday schools in the kingdom; it contains eighty-four class-rooms, and altogether has accommodation for 4000 children. Vernon Park, 26 acres in extent, containing many statues and fountains, was opened in 1858.

Stockport is of great antiquity, being supposed to occupy the site of a Roman military station; but its prosperity is of modern date. Its importance as a manufacturing centre is chiefly owing to the abundant supply of coal obtained at Poynton in the neighbourhood, and in the districts on the line of the Manchester and Ashton Canal, a branch of which communicates with this borough. Cotton weaving and printing are the principal occupations of the inhabitants; indeed, Stockport is one of the chief seats of this trade; but the manufacture of silk and woollen goods, thread, hats, brushes, shuttles, spindles, and machinery is also carried on. During the cotton famine (1862–64) many of the operatives were employed in improving the streets and sewers. There are several iron and brass foundries in the town, and a great number of bricks are made in the neighbourhood. The market is the most important in Cheshire for corn, oatmeal, and cheese.

The municipal borough is divided into six wards, and is governed by fourteen aldermen (one of whom is mayor) and forty-two councillors. The parliamentary borough returns two members; its limits are identical with the municipal boundaries. The population in 1881 was 59,543. The parish of Stockport is very extensive, having an area of 25,175 acres, and a population of 109,279.

STOCKS, a timber apparatus, formerly much used for the punishment of disorderly persons by securing their legs. Two semicircular notches on the upper edge of the fixed board of the stocks, and two others on the lower edge of the movable board, made, when brought together, two circular holes. The offender being seated behind the stocks, his legs resting in the notches, the upper board was brought down and fixed by its pins; and escape was then impossible, as the pins could only be unfastened by the parish constable, and meanwhile the holes were too small for the feet to be drawn through them. Sometimes holes for the hands were also used, but this more particularly belonged to the similar punishment of the pillory. In both punishments the great motive was to put the offender to open shame, as he could not fly from the derisive insults which assailed him. The time when they were introduced into England does not appear, but they are mentioned in the second Statute of Labourers, 25 Edw. III. (1350). In 1376 the Commons prayed the king for their establishment in every village, and in 7 Henry IV. (1405) they were so established by Act of Parliament. In "King Lear," act ii., scene 2, Shakespeare has introduced the stocks upon the stage. Farmer, commenting upon the passage, says, "It should be remembered that formerly in great houses, as still in some colleges, there were movable stocks for the correction of the servants." The last pair of stocks seen in London remained until a comparatively recent date in Portugal Street, Lincoln's Inn Fields. They are still to be seen in some country places, but they are entirely disused. A whipping-post usually adjoined the stocks.

STOCKS, in horticulture, are young trees designed for the reception of the grafts or buds from other trees. This process is called grafting or budding [see GRAFTING], and the object attained by it in gardening is the securing the continuance and multiplication of an individual plant that may possess peculiarities deemed worthy of preservation. It is thus the great number of varieties of cultivated fruits are preserved with remarkable integrity, and by this means a constant improvement may be insured. Stocks are for practical purposes divided into three kinds—crab stocks, free stocks, and dwarf stocks. Crab stocks are those which are grown from the seeds of wild and ungrafted trees, as the cherry, plum, apple, &c. These are commonly used where a large and hardy growth is desirable. In the selection of wild stocks, those which grow cleanest, and are freest from irregularities of the stem and defects in the bark, should be chosen. Free stocks are those raised from the seeds or layers of fruit and orchard trees which have been grafted, and are found desirable when the object of grafting is to obtain choice varieties of apples, peaches, nectarines, apricots, or plums. Dwarf stocks are raised from low-growing shrubby trees, and are used in the grafting of low standards for small gardens, also for wall-trees and espaliers.

STOCKS, GOVERNMENT, a term applied to the various funds which constitute the National Debt. In 1887 the capital of the unredeemed funded debt of the United Kingdom amounted to £709,000,000, and of the unfunded debt to £26,000,000, while the estimated capital of terminable annuities was £43,000,000.

Each proprietor of stock may transfer his interest to others by sale. When the transfer is effected by a broker, he must be authorized by a power of attorney from his principal. Few persons buy or sell stock except through the medium of a broker, but the general practice is to receive their dividends themselves, or by a banker to whom a power of attorney is given. On the bargain being completed, the parties repair to the Bank of England, where the actual transfer of the stock is effected. The purchaser acquires the dividend due upon stock for the current half-year purchased before the transfer books are closed for making out the dividend warrants. Formerly dividends were only paid at the Bank of England to the holders of the stock themselves, or to persons duly authorized by them to receive them, but the dividend warrants are now transmitted by post to persons who prefer it, provided they are resident in the United Kingdom.

Bargains in stock are transacted in the Stock Exchange, in Capel Court, Bartholomew Lane. The established rate of brokerage is one-eighth per cent. (or 2*s.* 6*d.* in the £100) upon the amount of stock transferred. There is no stamp-duty or tax of any kind upon transfers of Government Stock; but the transfer of Bank Stock under £25 costs 9*s.*, above that amount 12*s.* The dividends on all descriptions of stocks are due half-yearly—either on the 5th of January, April, July, or October.

Transactions in stock, together, of course, with many other kinds of investment, render the disposal of capital far more easy now than about 200 years ago. A lawyer or merchant at that time who had saved money was often greatly embarrassed to invest it safely and profitably. So great was the difficulty that Pope's father, on retiring from business, took with him to the country a strong box containing nearly £20,000. At an earlier period than the seventeenth century the same difficulty was probably the chief cause of the immense quantities of plate accumulated in private houses.

The source from which the interest is paid is called the Consolidated Fund, being, however, only an imaginary property, representing the credit of the country itself, which is pledged to the payment of the debts contracted by its government; the interest is paid half-yearly, and the document entitling the possessor to receive it may be sold and transferred from one party to another, just as any other kind of property. If money always brought in the same amount of interest, the price or value of £100 stock would always be the same—viz., the £100 originally paid for it or lent; but the value of money continually fluctuates, owing to commercial or political changes or expectations abroad and at home; and hence the price of stock rises and falls, according as money will fetch elsewhere a higher or a lower rate of interest. Thus, if at the time a person wished to sell £100 stock in the three per cents. money was very readily making ..ve per cent., it is plain that no one would give him £100 for the right to receive only £3; but since £60 of common or sterling money would now bring £3 interest, he would be able to sell his £100 stock for at least £60, and if that was all he could get the three per cents. would be said to be selling at £60. Practically, however, the good security of the government and the legal obligation to invest certain trust-funds in Government Stock make such stock always saleable at much more than the ordinary interest value.

STOCKS, LUMB, R.A., one of the best of the modern line engravers, was born at Lightcliffe, near Halifax, Yorkshire, in 1812. He was the pupil of Mr. C. Rolls. At first he was chiefly engaged on prints for books. He afterwards engraved several plates for Finden's gallery, and many of the best plates in the *Art Journal*. But he also engraved many separate prints for the art-unions of London and Glasgow, the Association for Promoting the Fine Arts in Scotland, &c. One of his largest and best prints was Frith's "Many Happy Returns of the Day," engraved for the Glasgow Art Union. His print of Webster's "Dame's School" is also much admired. Mr. Stocks was elected associate engraver of the Royal Academy in 1853, and R.A. in 1872. He died in 1887.

STOCK'TON, a city of California, and capital of San Joaquin County, is situated 3 miles east of the San Joaquin River, with which it is connected by a navigable creek or slough, 80 feet wide and 8 deep. It is about 50 miles S. by E. of Sacramento. The site is low, flat land, in the midst of an extensive and fertile plain. Stockton is supplied with fresh water by means of about 150 windmills, which pump it up through pipes which are inserted in the ground. It is sometimes called the City of Windmills. A railway connects it with San José and Sacramento, and a steamboat plies daily to San Francisco. It contains numerous churches, a fine hospital for aliens, the State Asylum for the Insane, the Stockton Seminary, a Female Institute, and great grain storehouses and flour mills. The town, which is the depot for all the southern mines, was incorporated in 1850. Its population in 1880 was 10,287.

STOCK'TON-ON-TEES, a parliamentary borough and port of England, in the county of Durham, situated on the northern bank of the Tees, 17½ miles south-east of Durham and 238 from London by the Great Northern Railway. The antiquity of Stockton is traced back to the Norman conquest, when it would seem to have possessed a manor-house that was one of the residences of the Bishop of Durham. In due time the house became a fortified castle, the moat of which is even at the present day clearly defined, although the castle itself was entirely demolished, and its materials sold, in the time of Cromwell. The principal street, which is wide and nearly a mile long, is very handsome; and at its southern extremity stands a stone bridge of five arches crossing the Tees, and connecting Durham with Yorkshire. The town has a perfect system of railway and telegraphic communication with all parts of the kingdom, and is remarkable as possessing the first railway—Stockton and Darlington—laid down in England. It has a well supplied market for the agricultural produce of the districts, held on Wednesdays, and being centrally situated, is resorted to by the inhabitants of all the country round, in addition to which Stockton imports large quantities of corn from Northern Europe. The chief source of its present prosperity is the iron of the neighbouring Cleveland Hills; and there are consequently large establishments in and near the town for the smelting, rolling, and casting of that metal; building iron ships, some as large as 3000 tons; constructing steam machinery, &c. In addition to the iron manufactures, but of secondary importance, there are sailcloth, tobacco, and bottle manufactories. The number of vessels registered as belonging to the port in 1887 was thirty (9500 tons). The entries and clearances each average 700 (150,000 tons) per annum. The population of the municipal borough of Stockton in 1881 was 41,015, and of the parliamentary borough (which returns one member to the House of Commons), 59,533.

The town hall, which contains a very convenient court of justice, stands in the centre of the High Street, and is surmounted by a clock tower and spire. Besides this the town has a handsome assembly room, mechanics' institution, dispensary, college, hospital, ragged school, temperance hall, custom-house, theatre, &c. It has several churches, and a fine Roman Catholic church by Pugin, besides places of worship for dissenters of all denominations; and in connection with them are some excellent charity schools.

STOCK'WORKS (Ger. *stockwerke*, floors or storeys) are irregular assemblages of metalliferous veins, so called from the German, in allusion to the successive tiers of

chambers in which they are ordinarily mined. There is no large main lode, but the mineral matter occupies radiating cracks and cavities or "nests," and forms an extensive network throughout the rock in which it occurs. Good examples are to be found in the tin workings of Cornwall, and also in those of Saxony.

STO'ICS, a celebrated philosophical sect of antiquity, founded by Zeno (Zenôn) of Kition, a town in Cyprus, about B.C. 308, and so named from the porch or stoa (Gr. *stŏa*) in Athens where he was accustomed to deliver his discourses. The Stoics always enrolled themselves as among the followers of Sokrates, and in fact Zeno was drawn to the study of philosophy by reading accounts of Sokrates' teaching. He then could not rest till he found, in Kratês the Cynic, his leader, one who resembled Sokrates the most nearly, as he considered, of all men on earth. Thus he derived the curious mixture of cynical and Platonic ideas. The Stoics are proverbially famous for the peculiar severity and harshness of their doctrines, which has rendered the word *stoical* a common synonym for remarkable sternness, austerity, or contempt of danger. Their studied contempt of pain and death, necessary in those ages as a protest against effeminacy and cowardice, is nevertheless fundamentally vicious. Man is born to pain, is highly susceptible of it, and it is mere affectation to stifle the expression of it, since the pain itself cannot be stifled. To moderate the expression were well enough if the Stoics had been content to rest there without seeking to emulate the passivity of inanimate nature. The influence exercised by their doctrines over the noblest minds of the ancient world is only comparable to that which Christianity has exercised over the best intellects of modern times. The principal features of their moral philosophy, enjoining a strict morality of conduct, an absolute disregard of pleasure, and an inflexible scorn of danger and death, are well known; but it is nevertheless no easy task to systematize their ethical precepts. Their leading teachers sought, it would appear, to reconcile a theological pantheism and a materialist psychology, originating with Heraklcitos, and an Aristotelian logic which made experience and experiment the basis of all knowledge, with a morality exalted and purified from that which lay at the foundation of the cynical philosophy, and centred in the entire free will of humanity. Man was his own master—

> "Our acts our angels are, for good or ill,
> The fatal shadows that stand by us still."

Life was what man made it, and pure or vicious according to his regulation of self: such was the grand central moral tenet of Stoicism. It might seem impossible to reconcile such apparently antagonistic doctrines as we have hinted at; and the manner in which the leaders of the sect set about the task cannot but fill the inquirer with admiration of their intellectual force, their keen intelligence, their mental resources, and their earnestness of purpose, while inducing him to regret their narrowness of vision and prejudice of judgment.

The philosophy of the Stoics, it has been remarked, was essentially polemical. On every side it presented "an armed front" to those who ventured to attack it. The scepticism of the Academy it attempted to confute by vigorously asserting the "truth of sensible perceptions," and upholding the judgments to which they lead by a strong protest in favour of the common sense of mankind as opposed to the theories of the schools. The Stoics taught that the soul was in infancy as a blank paper, whereon representations were afterwards inscribed by the senses; and thus alone, by experience, mind grew up. They would not recognize sensation as a passive affection of the mind; under certain conditions it became, they said, perception or comprehension, "a faculty whereby the mind reaches beyond itself, and *lays hold*, as it were on outward being." Experience enables man to form judgments and gather inferences which reason consolidates into philosophical systems. It is evident, then, that with the Stoics logic became a material and positive, not, as with Aristotle, a formal science.

In the other branches of their philosophy it is easy to discover a similar spirit of antagonism and controversy. Thus, the Epicureans advocated the natural science theory of Demokritos, which explained all physical phenomena as originating in the varieties of form and dimension of the ultimate atoms that make up the aggregate of every substance, and concluded that the primal cause of all things must have been "a fortuitous concurrence of atoms." Now the Stoics propounded as their explanatory hypothesis the existence of "a one all-pervading substance, a permeating ether, a creative fire, the source of life and law to the material universe." In point of fact, the universe consists of matter and force; the first being inert without the second, and the second being the manifestation and proof of the divine presence. This necessarily tended to induce a belief in a Universal Providence, which overruled chance and directed the progress of all things with a view to the ultimate happiness and perfection of the world. The same hypothesis furnished them with a ground for the first principle of their ethical doctrines. The supreme end of life is virtue; and this is to be rather attained by action than by contemplation. (Hence the attractiveness of Stoicism to the Romans, who were lovers of action.) Virtue brings happiness, but is not itself happiness, nor can happiness be an end in itself. Duty performed from a high motive is the highest result of conduct. The Stoics acknowledged this to be a purely impossible ideal; men were better the nearer they approached it. "Live according to nature" is with the Stoics the expression of the coincidence which ought to exist between the human will and the universal reason, which, as we have seen, they identified with the life and power of nature. This coincidence is virtue, the only good; as vice, its opposite, is the only evil. All things else are in themselves indifferent, being approved or disapproved only by comparison. Virtue is the perfect harmony of the soul with itself; vice is, in its essence, inconsistent and self-contradictory. The wise man, the ideal of human perfection, is absolutely, and without qualification, free. His actions are determined by his free will with a power as irresistible as that by which universal nature is guided and animated. In the one no less than in the other, freedom and necessity are one.

We have alluded to ZENO as the founder of this system, which influenced the progress of thought for nearly six centuries. His chief disciple was Kleanthês (300–220 B.C.), who was followed by Chrysippos, a Cilician (280–207 B.C.), and he, in due time, by Zenôn of Tarsos, Antipater of Tarsos, Panaitios of Rhodes, who introduced Stoicism to Rome, and Posidoniôs of Apamea, who was teacher of the great Cicero at Rhodes. In Rome the chief Stoic teachers were Cato the Younger, Seneca, L. Annæus Cornutus the poet, and Persius in the first century of our era, and later on the slave Epictetus (60–140 A.D.) and the Emperor Marcus Aurelius (121–180 A.D.)

(For fuller accounts of the Stoical philosophy the reader must, in the first place, consult the works of the ancients, Cicero, Diogenes Laertius, Plutarch, Sextus Empiricus, Seneca, Epictetus, and Stobaios. The best modern writers are Ritter, "History of Ancient Philosophy;" and Zeller, "Philosophie der Griechen." See also G. H. Lewes's "Biographical History of Philosophy," and Ueberweg's "History of Philosophy," English Trans., 1880.)

STOKE PO'GIS, a small village of England, in the county of Bucks, 20 miles from London, being 2 miles from the Slough station of the Great Western Railway. It is of interest as containing the churchyard of Gray's

"Elegy," with the ivy-mantled tower, the rugged elms, and the yew-trees' shade, where

"The rude forefathers of the hamlet sleep,"

and where the poet also has his resting-place.

STOKE-UPON-TRENT, a municipal and parliamentary borough of England, in Staffordshire, 15 miles north by west from Stafford, and 145 north-west from London by the North-western Railway. The parliamentary representation was reduced to one member in 1885. The population in 1881 was 64,091. The municipal borough—incorporated in 1874—comprises only the town of Stoke, and had in 1881 a population of 19,263. The area of the parish is 12,818 acres, and its population 104,313.

The town of Stoke itself has been much improved of late years, and is now pretty regularly built, well supplied with water, and contains many good modern houses. The town-hall and market form a large and handsome building. On the basement are the butchers' market and the police offices. The athenæum, established in 1846, occupies part of the town-hall. It has a free library and an interesting museum. An extensive market-hall, for fruiterers, &c., has been erected at the rear of the town-hall. The Minton Memorial Building is an elegant structure, erected by subscription, in memory of the late Herbert Minton, containing spacious rooms for the accommodation of the School of Desgin. Commodious public baths are attached to the building. St. Peter's Church is an elegant modern edifice, surmounted by a tower 112 feet high; it contains a monument to the memory of the celebrated potter, Josiah Wedgwood. There are numerous churches, chapels for dissenters, and several good schools.

The town contains some of the largest porcelain and earthenware manufactories in the Potteries; altogether there are upwards of 200 factories, and the well-known productions of Minton and Copeland have attained the highest excellence. Encaustic tiles and tesselated pavements are also made in vast quantities. The Trent and Mersey Canal passes through the town, and on its banks are numerous wharves and warehouses, from which much of the pottery is shipped. Stoke also contains the head offices and principal station of the North Staffordshire Railway. There are extensive coal mines in the vicinity. Lightfoot, the eminent Hebrew scholar, was born in Stoke rectory.

The towns and villages comprised in the Potteries are so near to each other that their limits are not easily defined, and to a stranger the entire district has the appearance of a large straggling town. With the exception of Burslem, in which the pottery trade was first carried on to any extent in England, they are all modern, and owe their origin and growth to the rapid development of resources and increase of population in this prosperous district. One of the small places in the neighbourhood of Stoke is *Etruria*, where Wedgwood commenced and continued his series of remarkable improvements in the manufacture of earthenware, raising it to the dignity of an art.

STO'LA, the characteristic dress of ladies in ancient Rome. It differed from the tunic, over which it was worn, in having an *instita* or flounce at the bottom, which, when adjusted, reached down to the instep, whereas the tunic only came just over the knee. The very long stola fell in many folds over the tunic. It was in shape like an oblong chemise cut open at top on both sides; the open ends were fastened above the shoulders by clasps or brooches. The stola was encircled by a girdle round the waist, and was then drawn up through the girdle till the edge of the instita, which if not shortened would lie on the ground, just touched the instep with its lower fold. The girdle was consequently quite concealed by the hanging fold of the bosom of the stola. Women not held in repute were not allowed to wear the stola, the special attribute of the chaste and dignified Roman women; and Horace pointedly contrasts the women of the toga with the matrons of the stola.

STOLE, originally a long vestment, a matron's robe (from the Latin *stola*, and that from the Greek *stolé*). In later times stola was the term more particularly applied to a long and narrow scarf, with fringed extremities, that crossed the breast to the girdle, and thence descended in front on both sides as low as the knees, the use of which was restricted to the clergy, and in the shape mentioned to those who were priests. The deacon, who was only permitted to wear it during the celebration of the holy mysteries, wore it over the left shoulder and, in the Latin Church, joined under the right arm, but in the Greek Church with its two extremities, one in front and the other hanging down his back. The word *hagios* was sometimes thrice embroidered on it instead of crosses. It is is one of the most ancient vestments used by the Christian clergy, and in its mystical signification reresented the yoke of Christ. It is sometimes called *orarium*.

The word stole, in the clerical sense, was of early adoption into the English language, as appears from the Saxon Chronicle under the year 963, when Archbishop Dunstan, at the time of personally confirming King Edgar's grant of lands to the monastery of Peterborough, added that he himself gave, among other vestments, his *stol* to St. Peter. The use of the stole was revived by the ritualistic party in the Church of England. See VESTMENTS.

STOMACH. One of the most constant characters by which animals are distinguished is the possession of an internal digestive cavity, in which their food is received and subjected to a peculiar chemical change before it is appropriated to the nutrition of the different parts of the body. The change is effected in every part of the cavity; but in some animals it goes on in one portion of it more especially, and this portion of the cavity is named the stomach.

The modifications of the great digestive duct or intestine known as the *alimentary canal*, supply facts of great interest to the student of systematic zoology. The members of the lowest subkingdom, the Protozoa, receive their food by a process of absorption over the whole surface of the body; but even, as will presently be shown in detail, the lowest form of the next highest group, *Hydra viridis*, the type of the Hydrozoa, has an alimentary canal rather hinted at than clearly defined. In the sea-anemones, the process of differentiation begins, and this continues to increase throughout the whole animal kingdom—complication of parts being less or more illustrated as we rise in the scale, till we reach the highly complex stomachs of the ruminant mammals.

The development of the stomach, and of the alimentary canal, is shown in the progressive series of diagrams of the Plates accompanying this article.

The simplest definite type is found among the hydras (fig. 1), the lowest class of Hydrozoa. These have a single internal digestive cavity, a mere sac, and mark the first step above the Protozoa, which digest anywhere on the body surface, and many of which get rid of substances not digestible by the simple process of turning themselves inside out. The hydra at least has a definite digestive structure. The next step is to the Actinozoa, the class of the anemones and corals, represented by *Veretillum cynomorium*, fig. 2, one of the family of the sea-pens or Pennatulidæ, which are freely-floating animals (or rather colonies of animals). These differ from the Hydrozoa in an important particular, namely, that whereas the hydras proper have one body cavity serving for stomach and all else, the Actinozoa have a digestive sac, separated by its own walls from the main cavity, hanging

into it as a separate bag, so to speak. If the Veretillum of the figure, for instance, were cut across in section, it would show two concentric rings, but the hydra of fig. 1 would show but one ring. The Echinodermata (represented by *Echinus saxatilis*, fig. 3) first possess a vent as well as a mouth. The alimentary canal is now a distinct tube all through the body, and remains so throughout the higher developments in the series of creation. The paradox therefore arises, that food taken into our alimentary canal is no more technically within our body (to be exact) than if it were held in the closed hand. So with the Echinus in fig. 3, its food might pass entirely through the alimentary canal, and would if undigested never be truly in the possession of the body. The Asteroidea, a still further developed order of the same group of the Echinodermata, and best known by the common starfish, though here represented by the Asterias, fig. 4, present the same digestive features still more emphasized. Another order of the same group (Echinodermata) is exemplified in fig. 7, *Holothuria tubulosa*, which is one of the sea-slugs or *bèches de mer*, often considered a great luxury as an edible. The length of the intestine and its numerous convolutions are noticeable, as well as the beautiful branched respiratory tubes which open, like the intestine, into the cloaca. Sea-water is admitted to the cloaca, and the respiratory tubes supply it thence to their clustered ramifications by the contractile power which they possess. These animals used to belong to the old division of Radiata, so named because of the very frequent radiation of their parts round a centre, the latter usually being formed by the digestive cavity.

The subkingdom Annulosa, of which the common garden worm is the most familiar type, is represented in the Plate by the common leech, *Hirudo vulgaris* (fig. 5). The ring-like segments which give the general title to the subkingdom are well shown. Here the mouth is a powerful "sucker," with blunt teeth. The alimentary canal now begins to show signs of a stomach proper, though this is not functionally marked off, or at least not very clearly so, from the general food-tube. The so-called stomach or anterior portion of the alimentary canal has eleven membranous pouches or diverticula on each side. Very high in the Annulosa comes the class of Insects, and here the digestive apparatus begins to become very complex. In fig. 6 is shown, separated from the body, the alimentary canal of the common cockchafer (*Melolontha vulgaris*): and the long gullet, the stomach proper, and the intestines are sharply differentiated. Here then, at last, we have a clearly defined stomach or mainly digestive cavity, as distinct from an intestinal or mainly absorptive cavity. Fig. 9 gives a specimen from another class of the Annulosa, namely the Myriapoda, the example chosen being the digestive apparatus of the common millepede (vulgarly called centipede, *Iulus terrestris*). It presents much the same general type as Melolontha. Another highly developed class of the Annulosa is the Arachnida, the scorpions and spiders, whose alimentary canals are shown in figs. 11 and 12. Here the mouth opens into a pyriform pharynx or elastic chamber, and it is believed that this acts as a sort of pump, which alternately is squeezed empty and then rebounds to form a sort of vacuum; for these creatures live by sucking the blood of their prey. The sac squeezes out the blood direct into the intestine, as the fluid needs no great amount of digestion, and a distinct stomach is unnecessary. Into the intestine, which is long and straight, the very large salivary glands pour their secretion from each side. In the spiders (as *Aranea domestica*, the common house-spider, fig. 12), long cæcal prolongations, the use of which is not certainly known, extend from the alimentary canal far into the limbs. It has been thought that these fulfil the functions of a kidney.

The next subkingdom, as we rise in order, is the Mollusca, the snail being the popular type. In fig. 8, the digestive system of the great class of Cephalopods, best known by the cuttle-fish, &c., is represented by that of *Loligo vulgaris*, the common calamary or squid. The stomach here is a very firm organ of characteristic shape; the intestine is comparatively subordinate. The funnel, which by expelling the water violently drives the animal backwards through the sea, is seen in the figure. This funnel clears away the used-up water of respiration, and also the excreta of the intestines and other organs.

The oyster (*Ostrea edulis*, fig. 10) is a very familiar object; it is by far the best known of the bivalve Lamellibranchs, which form another division of molluscs. The digestive apparatus of the oyster, on being dissected out, shows a mouth opening into a short gullet which ends in a well-formed stomach. The intestine makes a quick decided flexure upon itself, and afterwards forms a partially developed figure-of-eight curve, in the course of which it perforates the heart. The anus or vent is close by the respiratory aperture. In the oyster and nearly all lamellibranchs a sac at the pyloric end of the stomach contains a transparent glassy rod-like body, which has been named the "crystalline style," but whose office is as yet quite unknown. The liver in these animals consists of numerous cæca or pouches, which surround the stomach and open into it by various ducts.

In all vertebrates the several digestive organs are completely marked off, and the stomach and intestines have quite separate and widely differing functions; the intestines are therefore treated of in a separate article in this work. The œsophagus or gullet may, however, be regarded as part of the stomach, and on reviewing its variations among vertebrates we find them very considerable. It is sometimes much wider and shorter than in man, relatively speaking, and all fishes are an example of this; and instead of being merely elastic it may be extremely distensible, as in serpents. It may have a sac-like dilatation at its lower extremity, as in the "crop" of birds, or the similar structure in the gullet of the dormouse, the only example of that kind among the Mammalia.

The gullet has been said to be fairly regardable as part of the stomach, and indeed in most fishes the two are actually continuous without any marked constriction or division. The same occurs in some birds, for example, in the cormorant; and in all birds the "proventriculus" might as well be held to be a dilated end of the œsophagus as a part of the stomach.

The stomach of most birds possesses a markedly characteristic thickening of the muscular coat of the pylorus, and this is called a gizzard. Its use is to grind up the grain, &c., on which the birds live, and it is aided in this function by small stones and such substances swallowed by the bird and retained by the gizzard. Such an organ is found in at least one of the Mammalia, namely, in the great ant-eater. On the other hand the cardiac end of the stomach may be enormously prolonged, as in the bloodsucking bats, the pyloric end of whose stomach is almost aborted. See Pteropus, the vampire bat (fig. 19).

Of the stomach of mammals, man's own division, the stomach of the pig most nearly resembles that of man, as may be seen by reference to fig. 13, Plate II. Yet even here there is a marked difference, for the cardiac fundus is dilated into a little pouch at *a*, and two parallel folds are observed in the coat of the stomach leading from the œsophagus (*o*) to the pylorus (*p*). In opposition to the short thick stomachs found in the insectivores and in the ornithorhynchus, mammalian stomachs are long shaped; but in none is this more remarkable than in the kangaroo (fig. 14), which has an enormous prolongation of the cardiac end, and the semnopitheci, the long-tailed monkeys of India, with an exceedingly long and folded or puckered enlargement of the pyloric end of the stomach.

The greatest complexity of stomach is attained among the ruminants; and the sheep's stomach (fig. 20) has been

selected as a perfect specimen of this type. Here the half-chewed grass arrives by the œsophagus (*o*), and is thrust into the large dilatation of the cardiac end of the stomach called the *rumen* or "paunch" (*r*), or into the smaller dilatation called the *reticulum* or "honeycomb" (*h*), because of the appearance of the numerous folds of its inner coat crossing one another at right angles. When the paunch is full the animal lies down to ruminate; and the food, formed into a bolus or cud, probably by the honeycomb, is thrust up the gullet into the mouth, where it is thoroughly rechewed and swallowed a second time in a fluid condition. It now flows over the more solid mass in the honeycomb, directed also by folds of the inner coat of that organ, almost uniting so as to form a tube (see also fig. 16), into the pyloric end of the stomach. This, like the cardiac, consists of two chambers. The first of the pyloric chambers is the *psalterium* or "manyplies" (*ps*), which derives its name from the vast number of longitudinal folds of various heights, looking almost like the leaves of a book (psalterium) when this part of the stomach is cut open, as well shown in fig. 16. This strains the food very thoroughly and keeps back anything but properly masticated matters. All it lets pass goes into the large second pyloric chamber or *abomasum* (*ab*), where it is submitted to proper gastric digestion. Eventually it passes out through the pylorus (*p*) into the duodenum (*d*), the first part of the small intestine. The camels differ from this structure by their œsophagus opening solely into the paunch, not equally into the paunch and honeycomb: the latter is supplied from the paunch. The manyplies is a mere passage without the characteristic laminæ, while the fourth chamber is as usual, except for a dilatation, at the pyloric end, and is sometimes called a fifth stomach. But the characteristic peculiarity of the camel lies in its "water cells" (fig. 17), diverticula developed in the walls of the paunch, which strain off the water from the contents of that organ and store it up in considerable quantities. Camels have been killed by travellers who might have perished of thirst for the sake of this stored-up water, and the animals themselves, on account of this provision, are enabled to go a long way in desert lands without the necessity of drinking.

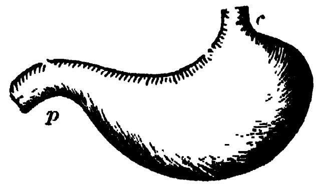
The Cetaceæ, or whale group, have a threefold stomach, as in *Phocæna vulgaris*, the common porpoise (fig. 18). The œsophagus (*o*) opens into the first stomach, large, conical, and lined with coarse white epithelium. This communicates with the second stomach by a curved passage, an inch long and distendible to about half an inch in diameter, shown by the bristle in the figure. The second stomach is lined by an extremely vascular and soft mucous membrane with about ten strong longitudinal folds, separated by deep furrows. A narrow and curved canal leads from it into the third smooth-lined stomach, of tubular form and bent somewhat S-fashion. This communicates with the intestines—that is, the duodenum (*d*)—by a circular pylorus (*p*), and as the pyloric end of the duodenum is somewhat dilated, as in the figure, this is sometimes, by an absurd error, called a "fourth stomach." It is clearly part of the intestines, with which its lining membrane is continuous, and besides it is beyond the pylorus.

The stomach of rodents is simple or slightly divided, as in the hare, *Lepus timidus* (fig. 15).

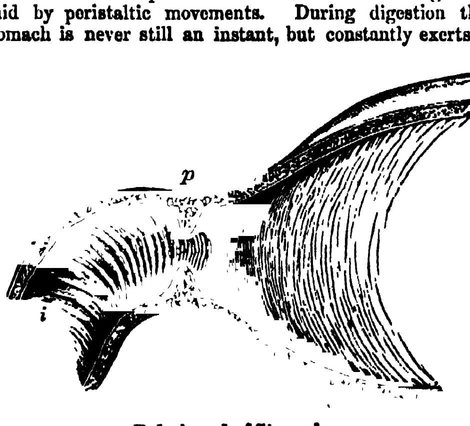
Without more exaggeration than is necessary for the point of the remark, it may be said to have been shown above (and illustrated in Plate II.), that the highest Mammalia have usually a single stomach, marsupials and rodents usually a somewhat twofold one, whales a triple stomach, ruminants a fourfold, and camels a fivefold stomach.

The *human stomach* is a membranous sac of an irregularly conical form, which lies almost transversely across the upper and left portion of the abdominal cavity. Its larger extremity is directed to the left, its smaller to the right. To the left it is in contact with the spleen; to the right, with the liver; above it is covered by the diaphragm, and at about one-third of the distance from its left to its right extremity it communicates, by an orifice called the cardia, with the œsophagus; at its right end it opens by another orifice, named the pylorus, into the intestinal canal. Of these orifices the pyloric lies rather lower than the cardiac; they are separated from each other by the upper and shorter border, or small arch, of the stomach, the greater part of the cavity being formed as if by the dilatation of the left side of the œsophagus into a great cul-de-sac and great arch, which form the left and inferior boundary of the stomach.

The coats of the human stomach are composed of three distinct membranes, connected by a firm but very extensible cellular tissue. The external or peritoneal coat is a layer of fine compact cellular tissue, woven into a thin membrane, and covered by a fine cuticle or epithelium, from which, like all the other organs within the abdominal cavity, it obtains a perfectly smooth and polished surface. Between the peritoneal and the internal or mucous membrane occurs a stratum of loose cellular tissue, in which are inlaid the fibres of the middle or muscular coat. This is composed of three different sets of fibres, resembling in their structure those of most involuntary muscles. The function of this triple muscular coat is to aid the gastric fluid by peristaltic movements. During digestion the stomach is never still an instant, but constantly exerts a sort of churning movement on its contents, faint at first, but increasing in strength as digestion proceeds. The food travels from the cardiac orifice to the pylorus by the great curve and returns by the small, and during its progress is constantly mixed by cross currents. Strong circular currents are set up at the sphincters, so that when food enters the cardiac orifice from the gullet it instantly closes upon it and forces it forward into the churning mass, while the constant pressure at the pylorus tends to force out the food as soon as it is sufficiently digested, and drive it on into the intestines. The muscular coat



Shape of the Human Stomach.
c, Cardiac orifice; *p*, Pylorus.



Pyloric end of Stomach.
p, Pylorus. *i*, Small intestine; duodenum.

also makes the stomach adapt itself to its contents, so to speak, so that it is always just full, and exerts a firm pressure on the food during gastric digestion.

The interior or mucous coat of the stomach is that in which the essential apparatus for the production of the digestive material is placed. To the naked eye it appears as a soft spongy membrane, about one-tenth of an inch thick, with a polished slippery surface.

The more intimate structure of the mucous membrane can be seen only with the aid of the microscope. If its surface be examined with a lens whose magnifying power multiplies diameters about forty times, it appears to be covered by minute polygonal fossæ, from $\frac{1}{100}$ to $\frac{1}{350}$ of an inch in width, surrounded by narrow sharp-edged borders, to which leaf-like processes are sometimes attached. At the basis of each of these fossæ there are, at least during digestion, from six to ten minute apertures leading into tubes which pass vertically into the substance of the mucous membrane. A thin section of the membrane made perpendicularly to its surface shows that nearly its whole substance is composed of these tubes, which are minute cylindrical glands, opening on the surface in the fossæ just described, but closed below, and set compactly side by side in groups. The small bloodvessels pass vertically in the cellular tissue between the groups of tubules from the submucous tissue to the surface of the stomach, on which they form an angular network, marking out the borders of the shallow fossæ. The office of these tubules seems to be the production of cells containing the fluid for digestion. These cells are of an oval form, about $\frac{1}{1000}$ of an inch in length; and, as fast as they are produced, they are pushed towards the orifices of the tubes, from which, while digestion is going on, they are discharged in such numbers as to form, with a small quantity of fluid separated at the same time, the thick layer of mucus by which the whole interior of the stomach is lined, and by which the portions of food are invested.

During digestion there are also often found, just beneath the surface of the mucous membrane, around either the cardiac or pyloric orifice, and along the lesser arch of the stomach, a number of small closed sacculi, filled with an opaque white fluid containing cells, which, when their contents are matured, burst and discharge them into the interior of the stomach.

The distinctive character of the fluid contained in tl cells formed by the tubular gastric glands is, that it holds in solution a peculiar chemical principle, to which the name of pepsin has been given, and which, in conjunction with a small quantity of acetic or muriatic acid, constitutes the true gastric juice or digestive fluid. It may be extracted from the mucous membrane of the stomach after death, and if a slightly acidulated solution of it be mixed with food, the latter will pass through the same changes as are produced by digestion in the living stomach or in the gastric fluid obtained during life, and will be at last converted into CHYME. See also the articles PEPSIN, GASTRIC JUICE, DIGESTION, &c.

A very serious question remains as yet unsolved: why does not the stomach digest itself, seeing that it wil digest exactly similar substances when swallowed? Th question is the more obscure because the stomach is found really to digest itself after death; and often in *post-mortem* observations the surgeons find digestion of the walls to have taken place, and the contents of the stomach to have escaped into the abdominal cavity. The best answer as yet seems to be that of Dr. Pavy, who relies upon the pronounced alkalinity of th blood which is supplied in such large quantities to th coats of the stomach during digestion, and which neutralizes the biting acidity of the stomach. The other main theory, that it is the presence of the protective mucous coat, is destroyed by experiment, for when this coat has been dissected away animals have lived quite well long fterwards.

STOMACH, DISEASES OF THE. Diseases of the human stomach may be conveniently classed as inflammatory, structural, and functional. *Inflammation of the stomach*, or *gastritis*, may be acute, sub-acute, or chronic. Idiopathic gastritis is a rare disease, and when acute inflammation does occur it is generally due to direct injury, the presence of indigestible substances, or of an excessive amount of alcohol. Sometimes it occurs in gouty and rheumatic subjects, its symptoms being relieved when the disease appears in the joints, and it is also apt to appear in connection with cirrhosis of the liver, and some forms of heart or lung disease. The symptoms of this affection vary considerably, but they generally include intense pain in the epigastric region, nausea, vomiting, thirst, an increase of temperature, a small, quick, wiry pulse, and a confined state of the bowels. In uncomplicated cases the prognosis is usually favourable, but it is a very serious complication of any other disorder. The treatment of this affection must of necessity be adapted to the circumstances of each case, the general principle to be kept in view being that of giving the stomach as much rest as possible. In severe cases entire abstinence from food for twenty-four or forty-eight hours may be necessary, the thirst being allayed by allowing small pieces of ice to dissolve in the mouth. The pain attendant upon this affection may be relieved by the use of warm external applications, such as hot linseed-meal poultices, hot fomentations, &c., the application of a few leeches, or dry-cupping, being useful in severe and obstinate cases. In prolonged cases the use of nutritious enemata and opiates becomes necessary, and during recovery the food taken must consist of liquids only, given in small quantities at a time. *Sub-acute gastritis* is often the consequence of errors in diet, either through the taking of an immoderate quantity of food, food of an indigestible character, or it follows upon a debauch. Pain in the head is often a prominent symptom, frequently accompanied by nausea, the pulse being feeble and the extremities cold. Treatment includes the unloading of the stomach and bowels, rest, abstinence from food for a time, the application of sinapisms or other counter-irritants to the epigastrium, and in some cases the administration of anodynes. *Chronic gastritis* is a very common disease, which may come on gradually by itself, or it may follow the acute or sub-acute form. It is more common among men than women, and though it is not limited to any period it is usually a disease of the later periods of life. Where it occurs in early life it is often found to be a hereditary disease, the mother being much more apt to transmit it than the father. Of all causes errors of diet are most apt to induce it, and to increase its influence when it has once been set up. Thus, a too great use of animal food, the too frequent repetition of meals, the practice of eating to excess, imperfect mastication, and above all the immoderate use of alcohol, are among the exciting causes most commonly found associated with this disease. The symptoms of this affection are very numerous and varied, including as they do most of those associated with indigestion, such as fulness after eating, acidity, variable appetite, nausea, thirst, constipation, or where the inflammation has extended to the bowels, diarrhœa, headache, and tenderness of the abdomen. The treatment of this disease consists first, in the removal, if possible, of its exciting causes, a careful regulation of the diet, the breaking off of any evil habit that may have been formed in eating or drinking, the use of aperient and tonic medicines adapted to the strength of the patient and the condition of his stomach and bowels, the taking of adequate exercise, and bathing followed by vigorous friction of the skin.

The structural diseases of the stomach include fibroid thickening, softening, ulceration, and cancer. *Fibroid*

thickening, also termed induration, sclerosis, cirrhosis of the stomach, &c., is due to a morbid fibrous growth in the submucous areolar tissue, involving thickening of the coats of the organ, and it is probably caused by chronic inflammation of the tissue affected. The affection may involve a part or the whole of the organ, the pylorus being the part usually affected in the former case, a circumstance liable to render the case dangerous from retention of food. It is a rare affection, scarcely ever attacking those who are under forty years of age, and it is generally regarded as chiefly occurring in hard drinkers. Its symptoms include pain in the epigastrium, vomiting, impaired appetite, loss of flesh and strength, and the presence of a tumour over the part affected. Its symptoms are liable to be mistaken for cancer, and it is difficult to distinguish the more acute forms of fibroid thickening from the latter disease, the smoother surface of the tumour and the non-affection of the liver or other organs being the most likely points to enable a diagnosis to be made. It is a very serious disease, and as a rule it terminates fatally at the end of a period varying from a few months to several years. Treatment consists in the most careful attention to diet, and the use of opiates and suitable external applications. *Softening of the stomach* may be the result of inflammation, or it may occur in a great variety of morbid states which have as a common symptom a great depression of the vital powers, such as enteric fever, peritonitis, cancer of the uterus, &c. The softening may be confined to the mucous coat, or it may involve all the others. *Ulceration of the stomach* is a not uncommon lesion of that organ, occurring more frequently in women than in men, the majority of cases being observed between the ages of twenty and thirty, though it is not uncommon in later periods of life. It is more common among the poorer classes of society, and it is found most frequently among servant girls and poor underfed needlewomen. It is supposed by some that there is a connection between ulcer of the stomach and the arrest of the menstrual functions, but others consider this doubtful. Other causes of the disease are to be found in syphilis, tuberculosis, uterine affections, and diseases of the heart and liver. The symptoms of this affection include pain, which is felt soon after eating, and which continues until the stomach is relieved by vomiting or the food is digested, vomiting, acidity, thirst, flatulence, constipation, and the presence of a sore spot over the stomach, which may be found by a gentle pressure with the finger. When the disease has lasted some time there is usually considerable loss of flesh and strength, and its symptoms become aggravated by the discharge of blood from the stomach. It is a serious affection, and one that may prove fatal from inanition, the perforation of the walls of the stomach, or such excessive *hæmorrhage* as will produce syncope and death. On the other hand, the majority of patients who suffer from this disease completely recover, and there is good reason to believe that many cases of this disease are cured spontaneously without medical treatment at all. There is no specific remedy for this affection, the treatment of which must proceed, as in some of the diseases previously mentioned, upon the principle of securing as much rest as possible for the affected organ. The food taken must consist of liquid or such substances as can be taken in the form of a soft pulpy mass, milk where it can be digested being one of the best foods known. Very great success has attended the treatment of this disease by the restriction of the patient to an exclusive milk diet, the milk being taken alone, or mixed with water, lime water, or soda water, in small quantities at frequent intervals. Another form of food of very great value is the carefully prepared essence of beef. In severe cases it may be necessary to give the stomach absolute rest, and to sustain the strength of the patient by means of nutritive injections. Sudden hæmorrhage from the stomach calls for the use of astringents, opiates, ice, and the external application of cold, with complete rest in a recumbent position. It is a serious symptom, and when it appears medical aid should be sought immediately. Slight bleeding taking place in connection with the vomiting may not materially disturb the general health, but when it occurs there is always the danger of the deeper and larger vessels of the stomach becoming involved. *Cancer of the stomach* is much less common than simple ulceration, but with the exception of the uterus the stomach is more frequently the seat of cancer than any other organ of the body. In this situation the disease is nearly always primary; that is, the affection does not make its appearance previously in any other part. It is a complaint of mature life; and Dr. Brinton, who collected 600 cases, found the average age at death to be fifty, the greatest liability being between sixty and seventy. It is very rare below thirty, and up to forty the liability is scarcely equal to one-fifth of the whole. It is more common among males than females, cancer among females appearing most frequently in the breasts or the uterus. The causes of this affection are obscure. In many cases there is a history of hereditary transmission, but unlike several of the affections enumerated neither anxiety, poverty, nor intemperance seems to influence the development of the disease. The earlier symptoms of this disease are not easily distinguished from those caused by indigestion or ulceration, but as the disease progresses there is loss of appetite, thirst, vomiting, and constant pain in the affected part. The sufferer rapidly loses flesh and strength, and the complexion acquires a greenish or slightly jaundiced hue. In the later stages a tumour usually becomes perceptible near the middle of the epigastric region, and this, taken in connection with the changed complexion and rapid wasting, may be regarded as symptomatic of the disease. With respect to treatment, unhappily nothing can be done beyond supporting the strength of the patient and alleviating the pain caused by the disease, which is invariably fatal, and usually causes death in about a year from its commencement.

Of the functional diseases of the stomach the most important is INDIGESTION, which has been noticed under that heading.

STOMAP'ODA. See STOMATOPODA.

STOM'ATA (Gr., mouths), in botany, are small openings in the epidermis of plants, communicating with intercellular spaces, and serving for the admission of air and the escape of gases and watery vapour. The structure of the stomata is best seen in the monocotyledonous plants, in which they generally occur of a larger size. They are quite imperceptible to the naked eye, but may be discovered by a lens of low power. In general they will be found to consist of two kidney-shaped bodies, which are merely cells coloured green by chlorophyll, from this circumstance contrasting with the transparent cuticle in which they are placed. These cells are the *guard cells*, and lie with their incurved edges presented to each other, and their extremities unite with each other so that they leave between them a little oval chink or opening. This opening communicates with the parenchyma of the leaf or other organ underneath the cuticle, and at this point the cellular tissue is loose, and frequently a large cavity is observed, into which the stoma opens.

The stoma originates by the division of a young epidermal cell into two, the guard-cells. The lamella separating these two cells splits, and the cuticle of the epidermis is continued over the surface of the cleft, which is narrow in the middle of the guard-cells, wider within and without. The size of the opening is affected by changes in the form of the guard-cells, which are brought about by the action of light on the chlorophyll contained in them.

The stomata are mostly arranged irregularly upon the

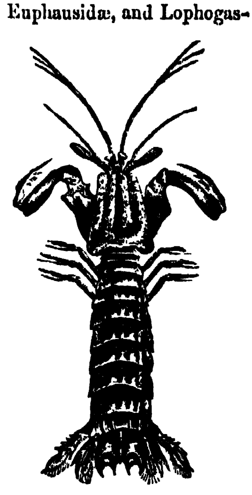
surface of the epidermis, occupying generally about equal distances from each other. There are, however, some remarkable exceptions. In the grasses, for instance, and some other monocotyledonous plants, they are arranged in regular rows, which run parallel with the bundles of woody tissue that enter into the composition of the leaf. In some other plants (as Begonia), they are collected into little groups.

Stomata are found on plants whenever there is a distinct epidermis, and they exist on nearly all the parts exposed to the light. They are usually wanted in submerged organs, and are always absent from roots. They are most abundant in the green foliage-leaves, but sometimes occur in the flower on the petals or carpels, or even in the interior of the ovary (Ricinus). As a rule they are more abundant in woody than in herbaceous plants, in thick leathery leaves than in most with a thinner cuticle. Succulent leaves have very few stomata. They are most abundant on the lower surface of leaves, being sometimes absent entirely on the upper surface; but in the floating leaves of aquatic plants there are no stomata on the lower surface which touches the water. The number of stomata varies greatly in different plants. Many observers have occupied themselves in counting them. *Citrus aurantium* was found to have 409,824 on a square inch, and *Solanum sanctum* 448,704; *Viscum album* had only 200.

The chief function of the stomata is to bring about TRANSPIRATION, that is, the exhalation in the form of vapour of the excess of water which has been absorbed by the roots carrying nitrogenous matters in solution. The leaves of some plants, as alchemilla and some aroids, have in addition special stomata for excreting drops of water. These water stomata are larger than the ordinary forms, and their guard-cells are incapable of closing and opening the aperture. In the Saxifragæ and Crassulaceæ these water stomata are also found, opening into a well-defined gland; they excrete salts in solution in the water, such as calcium carbonate.

STOMATOP'ODA or **STOMAP'ODA** is an order of CRUSTACEÆ. This order contains crustaceans presentin considerable resemblance generally to the lobsters, of the order Decapoda. They have a large elongated body with a broad well-developed abdomen, terminating in a very large caudal fin. The segments of the body are much less coalesced than in the lobster. The carapace is nearly quadrilateral, thin, and flexible, and leaves the anterior part of the head and the posterior segments of the thorax quite uncovered. (See Plate II. CRUSTACEÆ, figs. 6 and 7.) The first pair of antennæ are long, with a long three-jointed base, bearing three many-jointed filaments. The second pair of antennæ are shorter and more externally placed; they have at the base a large scale, and terminate in a single many-jointed filament. The eyes are at the ends of movable stalks. The mouth organs consist of a pair of mandibles, provided with a slender three-jointed palp and a small pair of maxillæ. The five following pairs of appendages are crowded together close to the mouth, and bear at their base a disc-like plate which assists in eating. These jaw-feet or maxillipeds end in chelæ or pincers, formed by the terminal joint being doubled back upon the penultimate, like the blade of a knife. The chel. of the second maxilliped is very large, and forms a powerful organ of prehension, the terminal joint being furnished with a row of long sharp teeth. The last three segments of the thorax are quite free and bear three pairs of biramous swimming feet. The abdominal swimming feet bear the gills, which are attached freely to their bases. The species of Squillidæ, to which this order is now generally restricted undergo a complicated metamorphosis, and the various stages of the larvæ were formerly considered distinct animals (Alima and Erichthus). These crustaceans are foun exclusively in the warmer seas in deep water. They swim rapidly, and are voracious and carnivorous. The best known species is the Mantis Crab (*Squilla mantis*), which is 6 or 7 inches long, of a pale yellowish-gray colour; it is found in the Mediterranean.

The three families Mysidæ, Euphausidæ, and Lophogastridæ are by some ranked in this order, while for others they form the order Schizopoda. None of the thoracic feet are prehensile, but are adapted for walking and swimming. Special branchiæ are absent. The females of the Mysidæ (Opossum Shrimps) and Lophogastridæ bear special appendages on their thoracic feet, which form a brood-pouch in which the eggs are hatched and the young pass the early stage of their existence. In Euphausia, the young hatches as a Nauplius, and passes through similar stages to some of the crabs. The Mysidæ or Opossum shrimps swarm countless numbers in the Arctic Seas, and form a large part of the food of the whalebone whale.



Sea Mantis or Mantis Crab.

STONE, a market-town of England, in the county of and 7 miles north by west from Stafford, and 138 from London by the North-western Railway, is situated on rising ground on the left or north-east bank of the Trent, over which, on the Stafford road, is thrown a substantial bridge. The principal street lies along the road from London to Liverpool, and is paved. St. Michael's Church is a modern building at the south-east end of the town, and near it are some remains of an ancient Augustinian monastery, originally established in the Saxon times. There are Congregational and Methodist chapels, two convents, and various benevolent associations. A market hall was erected in 1868, and a town-hall and mechanics' institute in 1870, on the site of the old Blue Bell Inn. The principal trades are shoemaking, malting, tanning, and brickmaking. The population in 1881 was 5669. Stone is supposed to owe its origin to a monastery founded in 670, afterwards made subservient to that of Kenilworth. Meaford, in Stone parish, was the birthplace of Sir John Jervis, afterwards Earl St. Vincent, from his great victory over the Spanish fleet off Cape St. Vincent, on the 14th February, 1797.

STONE, the common general name given to the coherent and more or less compact varieties of ROCK, which are described in detail under their respective headings. For building purposes, the most important in this country are the various limestones. The *Magnesian Limestone* [see LIMESTONE] of Durham, and the different kinds of Oolite of the JURASSIC PERIOD, such as the Bath Stone and the Portland Stone, have furnished the material for most of our finest public edifices; and the carboniferous limestone is also often employed in the immediate neighbourhood of quarries in that formation. As a rule, the most compact and crystalline varieties of limestone are those that are most durable. Sandstones are likewise used to a considerable extent in districts where suitable kinds occur, especially in areas occupied by the OLD RED SANDSTONE and the NEW RED SANDSTONE, and certain divisions of the CARBONIFEROUS and SILURIAN formations. Their durability depends upon the nature of the cementing material by which the grains of sand are made to cohere [see SANDSTONE]; also upon the presence or absence of numerous

flakes of mica and still more easily decomposed minerals like felspar. The most important flagstones are obtained from the MILLSTONE GRIT series of Lancashire and Yorkshire, and from the still older Caithness Flags (Old Red Sandstone) in the North of Scotland. Road-stone, except in the case of paving blocks for large towns, varies in different districts according to the products of the neighbouring pits and quarries; but for roads with much traffic it is always desirable to select stone of a not too homogeneous texture, to prevent the surface from becoming slippery. Granite is thus a more suitable road-metal than basalt, and so also are the harder varieties of sandstone.

STONE (disease). In its extreme form of stone in the bladder this is probably the most painful of ordinary human maladies. Stone has been described in its various forms under the more general term CALCULUS. It only remains here to consider what steps those unhappy persons should take who have inherited a "lithic acid diathesis," to endeavour to defeat so dire a foe. Those whose parents have had gout, or stone, &c., and who perceive warning symptoms in themselves, often in youth or in early manhood, may take comfort in the fact that if caught before it is deposited as stony crystals, lithic acid in any form will combine with potash to make a soluble salt which will be safely excreted. Once the deposit is permitted to accumulate, it is insoluble, and only to be got rid of by actual removal in its solid form—a most painful proceeding, if indeed it be possible without surgical operation.

Potash (caustic potash) is a strong irritant poison by itself, and neither its carbonate nor bicarbonate are suitable as foods, because the former is still somewhat caustic, and the latter, though almost neutral, would be deleterious by combining with the acid constituents of the gastric juice.

The proper potash compounds to be used are those which correspond to the salts existing in the juices of vegetables and flesh—viz. compounds of potash with *organic* acids, such as tartaric acid, which forms the potash salt of the grape; citric acid, with which potash is combined in lemons and oranges; malic acid, with which it is combined in apples and other fruits; the natural acids of vegetables generally; lactic acid, in milk, &c. Lemons and grapes contain these potash salts most abundantly. Those who cannot afford to buy them habitually as articles of food may use cream of tartar, which, when genuine, is the natural salt of the grape.

These organic acids are very easily decomposed by heat, and a simple experiment will show, on heating some cream of tartar on a slip of metal over a lamp flame, that the whole will burn away, leaving carbonate of potash behind. This represents quickly and briefly what occurs gradually in the human body, which is in a continuous state of slow combustion during life. The organic acids of the potash salts suffer slow combustion, give off their excess of carbonic acid and wate to be breathed out or otherwise ejected, and leave behind their potash to combine with and render harmless the lithic acid which the same slow combination is developing, and which if left alone soon becomes so fearful a tormentor.

If we take potash in combination with a mineral acid, such as the sulphuric, nitric, or hydrochloric, no such decomposition is possible; the bonds uniting the elements of the mineral acid are too strong to be sundered by the mild chemistry of the living body, and the mineral acid, if separated from its potash base, would be most mischievous, as it precipitates the lithic acid in its worst form.

For this reason, all free mineral acids are poisonous to those who have a lithic acid diathesis; they may even create it where it did not previously exist. Hence the iniquity of cheapening the manufacture of lemonade, ginger-beer, &c., by using dilute sulphuric or hydrochloric acid as a substitute for citric or tartaric acid. The mineral acids used in producing the choicer qualities of very dry, high-priced wines, have undoubtedly aided to cause the operations of lithotomy and lithotroty to be included among the luxuries of the rich. The ordinary routine of indiscriminately prohibiting to gouty and rheumatic patients the use of acids or anything having an acid taste has probably arisen from experience of the fact that *mineral* acids do serious mischief, and that the alkaline carbonate of potash affords relief. The difference between the organic acids, which are decomposed in the manner above described, and the fixed composition of the mineral acids does not appear to have been sufficiently studied by those who prohibit fruit and vegetables on account of their acidity. Nearly all the organic compounds of potash, as they exist in vegetables and fruit, are acid. It may be desirable, in some cases, to add a little bicarbonate of potash to neutralize a suspected excess of acid and increase the potash supply. If this be added in small quantity to lemon-juice in water, or to stewed fruit, for instance, it diminishes the demand for sugar, a substance whose excess is mischievous to the class of persons we are considering.

STONE AGE. Throughout the greater part of the Old World now inhabited by civilized man, there are occasionally dug up relics of early human races which appear to have been unacquainted with the art of working metals, and which were in as low a state of civilization as many savage tribes at the present day. The remote period when these peoples lived is commonly known as the Stone Age, in allusion to the material of which nearly all their more important implements were made; and in Western Europe, at least, it corresponds more or less with the PLEISTOCENE PERIOD of geology, though extending in its latest phase to slightly more recent times. In a strict sense, of course, it must be understood as a *stage* in the progress of man towards civilized life, represented at some time or other in every part of the land he has occupied, not as any definite epoch of the past, separated from the present by a fixed number of years; for it is a matter of common observation that countries emerging from a state of savagery are more advanced in some districts than in others, chiefly owing to contact with comparatively civilized tribes migrating from other quarters, and it is very probable, if not quite certain, that the Stone Age still prevailed in the north-western areas of the Old World even after nations in the East had commenced to possess a written history. The period, moreover, must have been of immense duration, judging from the geological changes that have taken place since its commencement; and modern science distinguishes two well-marked phases, an older and a newer, which it will be necessary to consider separately. For these two divisions Sir John Lubbock has proposed the terms *Palæolithic* (Gr. *palaios*, ancient; *lithos*, stone) and *Neolithic* (Gr. *neos*, new), which are now generally employed; the former relating to the earliest times, when the stone tools were merely roughly chipped, without final smoothing and polishing; and the latter indicating the subsequent stage, at which many of the implements were carefully polished and finished, or otherwise imply a more civilized race of workmen.

Implements of palæolithic age constitute the earliest undoubted evidence of man's existence in this part of the world. Certain discoveries in France and Italy, it is true, have been recorded as indicating the presence of human beings in those areas in the PLIOCENE, and even the MIOCENE PERIOD; but all these instances remain in need of further substantial confirmation. The first of the now accepted evidence of palæolithic date was obtained from the old river-gravels in the valley of the Somme, France, and began to attract general attention in 1858, though it had been discovered and described by M. Boucher de Perthes more than ten years previously. At this time several distinguished English geologists joined those of France in exploring the gravels in the neighbourhood of

Amiens and Abbeville, and confirmed all that had been stated in regard to the occurrence of flint tools in these ancient Pleistocene deposits. And shortly afterwards, Dr. John Evans called attention to similar discoveries in this country that had so far almost passed unnoticed; he described the magnificent implement in the British Museum, dug up with some bones of the mammoth in Gray's Inn Lane, London, about the middle of the last century, and also some smaller tools from gravels near Hoxne, in Suffolk. Subsequently, numerous implements have been met with under similar circumstances in several of our southern river valleys—especially that of the Thames and its tributaries—and the oldest of them are so much ruder than those found in slightly newer beds, that they may well have been made by a more primitive race than the latter, the so-called River-drift Man. This early hunter has also left traces of his presence in some of our caves, as that of Kent's Hole, near Torquay, where his tools are mingled with the skulls and bones of great cave-bears in the lowest bed of earth upon the floor. Of later palæolithic man, the caverns furnish considerably more evidence than the river-gravels, for he seems to have habitually used them as dwelling-places, and is thus commonly referred to as the Cave-Man. In the valley of the Thames, however, some most interesting remains have been discovered during recent years upon what are apparently former river-banks, now covered with sediment—accumulations of flint implements and flakes, mixed with bones of extinct animals—which are appropriately termed Palæolithic Floors. Near Crayford, Kent, in 1880, Mr. F. C. J. Spurrell found a spot where the implements were made, noticing a pile of flint flakes mingled with broken and unfinished specimens of workmanship; and in some cases he was able to replace the fragments that had been chipped off in their making—in one case, indeed, thus restoring the nearly complete original flint nodule as taken out of the chalk. [See paper published by the Geological Society, 1880.] Still more recently [Society of Antiquaries, 9th December, 1886], Mr. Allen Brown made known another remarkable floor at Acton, near Ealing, to the north of London; and discoveries of a somewhat similar kind have been recorded at Hackney and Stoke Newington, a few miles distant. The principal caverns in England that have thrown light upon the same subject, are those of Brixham and Kent's Hole, near Torquay; Wookey Hole, Somersetshire; Gower, Glamorganshire; Ffynnon Beuno, Vale of Clwyd, Denbighshire; Creswell Crags, Derbyshire; and Victoria Cave, Settle, Yorkshire. And others, like that of Kirkdale, in Yorkshire, have added important information in regard to the wild animals occupying the country at the time. The cave-man was evidently a hunter, ignorant of agricultural arts, and unaccompanied by domestic animals. His stone implements were mostly of flint or quartzite, and were variously used as dart heads, hammers, skin scrapers, borers, saws, and knives, sometimes, in all probability, being fixed in handles of bone or wood. And the wild beasts he captured were numerous and varied. The country at the time was occupied by reindeer, musk sheep, mammoths, and woolly rhinoceroses from the north; by brown bears, grisly bears, cave bears, wolves, bisons (the so-called buffaloes of the North American prairies), oxen, stags, and horses, now characteristic of north temperate climes; and by hyænas, lions, leopards, and hippopotami from the south. These and many other animals [see PLEISTOCENE PERIOD] occupied the land at some time or other, perhaps not all together, and many of the vegetable feeders provided sustenance and clothing for the sparse human population associated with them. Fishing was also practised, and several bone harpoons, more or less elaborately finished, have been discovered. Fire was known, and round the old hearths there are heaps of pebbles, which were probably used as pot boilers in the same manner as stones are said to be used by certain North American Indians at the present day, the want of all knowledge of metals and pottery preventing any ordinary process of boiling. The domestic art of sewing was likewise known, for several beautifully made bone needles have been met with; and there are also bone awls, which were very probably used for boring holes in the skins when the needles were too delicate. Reindeer sinews were most likely employed as thread, as is the case now among the Laplanders and the Eskimos. Still more interesting is the discovery of rude sketches of animals and hunting scenes upon some of the bones and teeth in the caves, a fact implying considerable artistic ability among the cave-men. Only one example has hitherto been met with in Britain—a small drawing of a horse's head upon a bone from the Creswell Crags, Derbyshire. But numerous good specimens are known both from France and Switzerland; and, among others, there is a most faithful representation of the hairy MAMMOTH, the long shaggy coat of which would probably have been ascribed to the artist's imagination, if we had not evidence of it in the bodies preserved in the frozen mud of Siberia. The seal, whale, reindeer, bison, and antelope are also depicted by these early huntsmen: and one drawing seems to represent a three-fingered glove. Some teeth are bored, as if for necklaces, and the people seem to have ornamented themselves with paint, if the occasional lumps of red raddle are rightly interpreted.

On the whole, palæolithic man appears to have been very much in the condition of the modern Eskimo prior to contact with civilized tribes; and Professor Boyd Dawkins and others believe that the denizens of the arctic latitudes are his still surviving descendants. Unfortunately, scarcely any human bones have been discovered, so that it is not possible to make satisfactory comparisons of the skeleton. But the very absence of traces of interments may be due to the prevalence of a custom still in vogue among the Eskimos—that of burying the dead so insecurely as rarely to escape the ravages of wild beasts.

The *Neolithic* people are regarded as a race of invaders, having no connection with the earlier tribes, but migrating westward from the east, and displacing the original inhabitants. And almost immediately after their arrival in this part of the world—even if not earlier—Britain became finally separated from the Continent by a narrow strip of sea. The island probably extended a little further than now in some directions, as indicated by our SUBMERGED FORESTS, and several estuaries and bays would then be low-lying plains. At this time the woodman's axe, with polished stone head, first came into use, and the arts of agriculture were widely practised. Domestic animals were also known, and the people have not inappropriately been designated as a race of farmers. In some places they took refuge in the caves and rock-shelters, like their predecessors; and interesting relics of them have been found in the more superficial layers of several of the English caverns already mentioned. But many of the tribes also constructed more or less elaborate habitations for themselves, and among the chief of these are the interesting LAKE-DWELLINGS, or Pile-dwellings (*Pfahlbauten*), of Switzerland. Here, upon piles, at some distance from the water's edge, the people erected platforms and huts—like the savages of New Guinea at the present day—and were thus protected from the bears, wolves, and their enemies. In other places, as, for example, near Salisbury, they dug small pits (hut circles), and roofed them with wickerwork, plastered with clay; while a primitive log hut discovered many years ago in a peat-bog in Donegal, Ireland, is supposed to have been made at the same early date. This interesting relic consisted of rough-hewn beams of oak, pegged together, and divided into two low storeys. Other dwellings were probably built of stone slabs, and many of these—or structures of a similar type—have been covered up with

mounds of earth, and utilized as places of sepulture for the dead. Such monuments are known as tumuli or BARROWS. The skeletons are very often accompanied by a collection of articles, which were perhaps intended for use in the spirit world; and the custom of burying in old houses is still to be observed among certain uncivilized tribes, who have apparently similar beliefs. The wild animals in this part of the world in neolithic times comprised the brown bear, the wolf, urus, bison, wild boar, reindeer, and the now extinct Irish deer; and among the domestic animals were the dog, ox, sheep, goat, horse, and two or three kinds of pig. Wheat was cultivated, and seeds were also used in the making of bread and ground by millstones. Flax was employed in the manufacture of linen, which formed part of their clothing in addition to skins. And the art of making pottery seems to have been skilfully exercised. The stone implements were numerous and varied, and the remains of several old mining shafts, as at Cissbury (Sussex) and elsewhere, testify to the method of obtaining the requisite fresh flint. The axes were mostly made of JADE, or nephrite, and must almost certainly have been brought from Asia, as no trace of this material has hitherto been discovered occurring naturally in Europe or Africa. The people were likewise warlike, having clubs, spears, and probably slings; and they had some idea of boating, as shown by their paddles and primitive canoes. In later times, the neolithic men were succeeded by those of the Bronze Age, and these again by those of the Iron Age. (See Sir John Lubbock's "Prehistoric Times;" Professor Boyd Dawkins' "Cave Hunting," and "Early Man in Britain;" Dr. John Evans' "Ancient Stone Implements;" and Professor James Geikie's "Prehistoric Europe.")

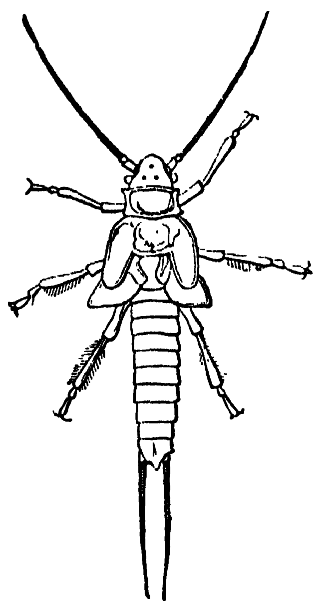
STONECHAT (*Saxicola rubicola*) is a British bird belonging to the family Sylviidæ or Warblers. The stonechat breeds on furzy commons and heaths throughout Britain, but is rather local in its distribution. It occurs chiefly as a migrant in Europe, except in the extreme south; its range extends to Asia Minor, Persia, and North Africa. The stonechat has a straight bill, broad at the base, long and rounded wings, short broad tail, and slender legs. Its total length is 5½ inches. It has the head, throat, and upper part of the back black, the lower back brownish-black, the breast chestnut, and the lower parts reddish-white. The sides of the neck, the upper part of the wings, and the rump are white. The female is lighter in colour than the male. The stonechat is an active and lively bird, constantly flitting from one bush or stone to another, and dashing off in pursuit of passing insects, which it captures in the air, all the time keeping up a continual twittering, from which its name of stonechat or stonechatter is derived. Its song is agreeable, though short. The nest is built early in April on or close to the ground, under the shelter of a bush; it is composed of moss and grass. The eggs are five or six in number, grayish-blue, mottled and speckled with reddish-brown at the larger end. The WHINCHAT (*Saxicola rubetra*) is an allied British species.

STONECROP, that familiar plant which *crops* out (*i.e.* bunches out) between the *stones* of a wall. See SEDUM.

STONE-CURLEW or **THICK-KNEE** (*Œdicnemus scolopax*) is a British bird belonging to the PLOVER family (Charadriidæ). The stone-curlew has long slender legs, with three toes only, directed forwards, and united by a membrane as far as the second joint: in the young there is a swelling at the joints of the legs, which afterwards disappears, and from this the popular name thick-knee, as well as the generic name, is derived. The bill is stout, strong, and straight, a little depressed at the base. The wings are moderate, and the tail is graduated. The stone-curlew is about 17 inches in length. The general colour of the upper surface is brown, the claw and throat are white, and the rest of the lower surface is brownish-white streaked with darker brown. The plumage of the two sexes is nearly similar. The stone-curlew has a wide range, being generally distributed throughout Europe, and extending into Egypt and Southern Asia as far as Burma.

In this country the thick-knee occurs only in the summer, arriving in April and departing about the end of September or early part of October. It is more abundant in the southern and eastern counties of England than elsewhere; and frequents especially the sandy plains of Norfolk, from which circumstance it is frequently called the Norfolk Plover. The food of these birds consists chiefly of worms, slugs, and insects, but they also devour small mammals, such as field-mice and reptiles. They frequent open districts, heaths, and fallow fields. and the female deposits her eggs upon the bare ground. The eggs are two in number, pale clay brown, with blotches, spots, and streaks of ashy blue and dark brown. These birds appear to be crepuscular or nocturnal in their habits, and their shrill whistling note is often heard at night in the solitary districts which they haunt.

STONE-FLY is the name given by anglers to several species of the family Perlidæ, which is a small family of insects belonging to the order NEUROPTERA. In this family the hind wings are broader than the fore pair, and are folded longitudinally when at rest. The body is elongated, flattened, and of equal width throughout. The abdomen is generally furnished with a pair of long jointed bristles. The antennæ are long, tapering, and composed of many joints. The males are much smaller than the females, and have their wings generally less developed. The larvæ resemble the perfect insects, except in wanting wings, and are aquatic and carnivorous. The perfect insects are found on palings, &c., on the banks of streams. The species of Perlidæ are not numerous, and are chiefly confined to the temperate parts of the world. Several species are British. The Stone-fly of anglers (*Perla bicaudata*) is about ¾ inch long, and of a brown colour; it appears in April. The Yellow Sally is the curious name of a smaller green species, *Chloroperla viridis*, which appears in May. *Neuram variegatea* shares with the last species the name of Willow-fly. A Canadian genus, Pteronarcys, the pupa of a species of which is figured, is remarkable for the persistence in the perfect state of the branchial tufts on the under side of the thorax with which the larvæ of its allies are often furnished.



Pupa of Pteronarcys regalis.

STONEHA'VEN, a small town of Scotland, the county town of Kincardineshire, situated 16 miles S.S.W. from Aberdeen, and 526 from London by rail. It stands on a flat terrace, between the shore and high cliffs westward. It consists of an old and new town, joined by a bridge over the Carron. The old town is irregular, and is chiefly inhabited by fishermen; the new town is better

built, and contains a market house, town-hall, county buildings, Free, U.P., Episcopal, and Roman Catholic churches. The harbour covers 5 acres, and is important for the fishing industry. The population in 1881 was 3957.

Dunottar Castle, about 2 miles south from the town, stands on a lofty peninsulated rock, projecting into the sea, being separated from the mainland by a vast chasm or natural fosse. The summit of the rock, which is mostly occupied by the ruins of the castle, comprises about 1¼ acre. This castle was, for a lengthened period, the property and residence of the noble family of Keith, earls marischal. It was forfeited and dismantled after the rebellion of 1715, on the attainder of its noble proprietor. Owing to its position, it was formerly a place of considerable strength, and has been repeatedly besieged.

STONEHENGE (Saxon, *Stanhengist*, hanging or uplifted stones), the curious memorial of a very remote antiquity, consisting of numerous large and artificially raised monoliths, situated on Salisbury Plain, 2 miles from Avebury in Wiltshire, and in the immediate vicinity of numerous British tumuli or sepulchral barrows. Regarding its origin and purpose a vast amount of conjecture has been hazarded. An old legend preserved by Geoffrey of Monmouth and Giraldus Cambrensis, attributes its erection to one Emrys or Ambrosius, the last British king, who designed it to commemorate 460 Britons murdered by the Saxon Hengist. Some ancient writers pretended that it was originally called *Choir Gaur*, or the Great Round Church; others that its ancient title was *Ambres*, or the Holy Stone. One antiquary has believed it to be an antediluvian memorial; another a sanctuary of the Danes; a third and no less eminent a person than Inigo Jones, a Roman temple! The general opinion now seems to be—and it is supported by Gibson, Stukeley, King, Davies, and Maurice—that it was a Druidic temple or else a burial-place. It is evidently the work of two distinct eras, and the outer circle would appear to have been erected by a people not unacquainted with iron tools, and Roman armour and pottery were found in 1620, and later, beneath the base of some of the fallen stones, lending weight to the belief that the date of the monument is subsequent to the Roman invasion. Much mystery, however, still enshrouds its origin and purpose. Thomas Warton sings—

"Thou noblest monument of Albion's isle!
Whether by Merlin's aid from Scythia's shore
To Amber's fatal plain Pendragon bore,
Huge frame of giant hands, the mighty pile
To entomb his Britons slain by Hengist's guile;
Or Druid priests, sprinkled with human gore,
Taught 'mid thy massy maze their mystic lore;
Or Danish chief, enrich'd with savage spoil,
To Victory's idol vast, an unhewn shrine,
Rear'd the rude heap; or, in thy hallow'd round,
Repose the kings of Brutus' genuine line;
Or here those kings in solemn state were crown'd:
Studious to trace thy wondrous origin,
We muse on many an ancient tale renown'd."

Stonehenge, when perfect, comprised two circles and two ellipses of upright stones, concentric, and surrounded by a bank and fosse. Outside the latter was a single upright monolith and a so-called *via sacra* or holy way. The entrance to the great cluster or circle fronted the north-east, and the road or avenue to it may still be traced. The traveller approaching Stonehenge by this route first reaches the isolated monolith called the Friar's Heel, a block 16 feet high, which by some has been called the *gnomon* or mark that guided the observation of the officiating priest to the rising point of the summer sun. It would appear to indicate the spot from which the builders calculated the ground-plan of the temple; for if a right line drawn from it towards the south-west be divided into four equal lengths of 60 cubits (or about 120 feet), the first space will meet the fosse, the second the outer circle, the third will span the circle, and the fourth touch the fosse on the further side. Another interval of 120 feet will carry one from the Friar's Heel to the temple's extreme boundary.

Passing some monolithic stones, whose meaning is unknown, and crossing the boundary, we advance another 120 feet to the temple itself—"to those huge old stones which have been standing here in their solitude, year after year, and century after century, wreck of an unknown time, a puzzle to the antiquary and a wonder to the passing traveller."

The outer circle consisted of thirty stones, fixed upright at intervals of 3½ feet, but connected at the top by as many imposts, which formed a continuous corona or ring of stones, at a height of 16 feet above the ground. These blocks were all squared and rough hewn, and joined together ingeniously. The uprights were cut with knobs or tenons, which fitted into mortise holes hewn in the under sides of the horizontal stones, and the imposts were dovetailed to each other. About 9 feet within this grand peristyle was the inner circle, of unhewn granite pillars about 6 feet high. And within this stood the most majestic portion of Stonehenge, the great ellipse, formed of five, or as some think, seven trilithons or triplets of stone, two upright and one crosswise, like the frame of a doorway. These imposing structures rose progressively in height from east to west, the loftiest and highest attaining an elevation of 25 feet. Finally, the inner ellipse consisted of nineteen posts of granite, similar to those of the inner circle, and inclosing the central altar-stone.

Such was Stonehenge in its palmy days, but it now presents a sadly altered appearance. It is, indeed, but "a confused pile of enormous moss-grown stones," which, according to the popular saying, cannot be counted twice alike. Of the outer circle only sixteen uprights and nine imposts retain their original position; of the inner circle seven stand upright; of the great ellipse two perfect trilithons and two uprights remain; of the inner ellipse there are six blocks in their places, and the so-called altar-stone.

The stones are believed to have been brought from Marlborough Downs, a distance of about 15 miles, as no stones of a corresponding character are found nearer. Similar stone circles exist in other parts of the world, and Sir John Lubbock refers them all to the bronze age.

It only remains to add that in 1645 Stonehenge was selected by Fairfax as the rendezvous of the Parliamentarian forces; and that in 1651 Charles II. came hither from his concealment at Heale House, near Amesbury, to meet the loyal friends intrusted with the management of his escape to the coast of Sussex, and thence to France. He amused his leisure, while waiting their arrival, in counting and recounting the stones. The most recent work on the subject is "Stonehenge; Plans, Descriptions, and Theories," by W. M. Flinders Petrie (1880).

STONEHOUSE. See PLYMOUTH.

STONES, SONOROUS, have been used as musical instruments in all ages. The Chinese *king*, a series of thin slabs of stone suspended on a frame and struck with a small mallet, is of untold antiquity. Its origin was already lost in the dim mists of prehistoric time when Confucius (Kung-fu-tze) heard it played five centuries before our era by the world-renowned Kouei, who, like Orpheus with his lute, could draw animals to the sound of his *king*. Its effect on Confucius was so wonderful that he was unable to eat properly for many weeks owing to his emotion. The time set for the invention of the *king* is 2000 B.C., when it was used in religious ceremonies and for the purpose of an *aubade* to wake the emperor. A sort of agate, very beautifully marked, the *yu*, which is chiefly found in mountain streams, is the stone now most esteemed for the *king*, because of its excellent retention of

the pitch when once tuned. Other stones are found to be affected by heat and moisture. The black stone called *hiang-che* is also esteemed for its remarkably metallic tone, providing an agreeable variety of tone-colour to the *yu*. The Chinese also use single sonorous stones, often drum-shaped and of considerable size, as musical instruments; such stones are called *tse-king*.

The classic nations also used such stones. The Roman Pliny (first century of our era) mentions a "brass-sounding stone" (*chalkophonos*) which, when struck, sounded like metal. It was black, like the Chinese *hiang-che*, and may be what we now call "clinkstone" (phonolite). He says that actors used it as a pitch-stone to attune the voice to in recitation.

Savages, both ancient and modern, have been found fully alive to the sonority of certain stones. Thus among the relics of the ancient civilization of Peru beautiful instruments of green sonorous stones, in bars of a foot long by an inch and a half, are found still giving forth most pleasant sounds when struck. Humboldt found thin stone plates used as musical instruments by the savages of the Amazon; and he found traces of the worship of such stones as possessed of divine powers.

In 1845 some Welsh quarrymen constructed a very perfect rock harmonicon of several octaves in compass; the stones lay horizontally, and owing to the width of the instrument more than one performer was required to play it. The effect was very pleasing and far less monotonous than might be expected. Only simple airs, harmonized in two or three parts, were attempted. The instrument was some time on exhibition in London. More or less perfect instruments of this class have often been produced. One of the latest is the *silex-piano* of Baudré, an earnest investigator of the subject. He collected a large number of musical stones, and among them had three very fine sounding flints, in 1852. From this year till 1885 he diligently sought for more, and during that time collected twenty-six flints, giving two octaves in semitones. Upon these one can play by striking the sonorous flints with other flints, and the sound is silvery, sweet, and ringing. Baudré's flints are suspended over a sounding board on two wires. Most remarkable variations occur in this interesting series. The deepest toned and most powerful flint weighs 4½ lbs., whilst that which gives the semitone higher weighs 9 lbs., and that which gives the next semitone only 1 oz. The same weight (1 oz.) is that of the most treble of the flints, nearly two octaves off. Two stones give the same note; one of them weighs 3 oz., the other 6000 grains. Such anomalies seem almost inexplicable. Our great tone-scientist, Mr. A. J. Ellis, F.R.S., has hazarded the following conjectures:—"We know not up to the present whether the sonorousness is affected by the form, bulk, chemical mass, or molecular constitution. It is very probable that these stones have internal structures that differ from each other—the sound of the stones being different when they are struck in two neighbouring places. I should not be surprised if there were a sort of obliqueness in the structure, which would explain the impossibility of preserving the sound when a singing stone is cut or broken. There is here an interruption of the sonorous waves that are passing through the body. The great difference in the sounds that two bodies of nearly equal bulk are capable of producing is probably due to a difference in the arrangement of their molecules, which govern the mode of vibrating."

STONESFIELD SLATE, in geology, a local deposit of laminated limestones and sandy flags, about 6 feet in thickness, quarried for roofing purposes round Stonesfield, near Oxford. It occurs at the base of the Great Oolite [see JURASSIC PERIOD], and is of extreme interest on account of its contained fossil remains, which are very abundant. There are numerous traces of land-plants, including ferns (Cyclopteris, Pecopteris, &c.), cycads (Bucklandia), zamias, and conifers. Land-animals are represented by insects—such as Mayflies and beetles, reptiles, and occasional mammals. The great MEGALOSAURUS is an especially characteristic fossil, and so likewise are the primitive crocodiles, TELEOSAURUS and STENEOSAURUS, and the PTERODACTYLES; the marine reptiles, ICHTHYOSAURUS and PLESIOSAURUS, also sometimes occur. Of the mammals, only small mandibles and one or two limb-bones have been discovered, and these seem to belong to little insectivorous creatures having their nearest living allies in certain MARSUPIALIA, or perhaps MONOTREMATA, found in Australasia. The most satisfactory specimens are named Amphitherium (doubtful-beast) and Phascolotherium (pouched-beast). Fish remains are discovered occasionally, though nearly always in a very fragmentary state. Among Mollusca there are limpets, oysters, and pectens, in addition to Trigonia (especially the characteristic *Trigonia impressa*), Lima, and Nerinæa; Ammonites and Belemnites also occur; and numerous Brachiopods of the genera Terebratula and Rhynchonella are met with almost everywhere. The formation is truly of marine, though shallow water origin, and yields all the most prominent types of life characteristic of the MESOZOIC ERA. (See Professor Phillips' "Geology of Oxford and the Thames Valley.")

STONEWARE, a species of potter's ware, a composition of clay and flint. The clay is beaten in water and purified, and the flint is calcined, ground, and suspended in water, and then mixed (in various proportions for various wares) with the former liquor. The mixture is then dried in a kiln, and being afterwards beaten to a proper temper, it becomes fit for being formed at the wheel into dishes, plates, bowls, &c. These are baked in a furnace, and glazed by common salt. The salt being thrown into the furnace is instantly converted into a thick vapour, and attaching itself to the surface of the ware, it forms a vitreous coat upon the surface.

STONY STRATFORD, a town of England, in the county of Bucks, situated on the Ouse, 52 miles N.N.W. of London, and 2 miles from the Wolverton station of the North-western Railway. It is built on the ancient Watling Street, along which it extends about a mile. The houses are chiefly of freestone. The church was rebuilt in 1777 and remodelled in 1865. There are places of worship for dissenters and a neat town-hall. Lace is manufactured to a small extent, and the town has also some trade in corn. Stony Stratford is supposed to occupy the site of the *Lactodorum* of the Romans. At an inn in the town the person of the young King Edward V. was seized, and Grey and Vaughan arrested by Richard, duke of Gloucester. The population of the parish in 1881 was 1948.

STO'NYHURST, a Roman Catholic college in the parish of Milton, in North-east Lancashire, about 4 miles south-west of Clitheroe. The college was founded in 1794 by some Jesuit fathers driven from Liège at the Revolution, and has grown to be the Catholic Eton. It occupies the old seat of the Sherbournes and Weldé, which has, however, been greatly added to, and the college now comprises three chapels, class-rooms, library, museum, observatory, gymnasium, &c.

STOP, a set of pipes of one quality. See ORGAN.

STOP, the mode of producing sounds of various pitch from one sounding-string. See STRINGED INSTRUMENTS.

STOPPAGE IN TRANSITU is the seizure by the seller of goods sold on credit during the course of their passage (*transitus*) to the buyer. This principle is said to have been established about 1690 in the Court of Chancery (2 Vern., 203), and it has since been acknowledged as part of the common law of England. This doctrine of stoppage in transitu entitles a seller, in case of the insolvency or bankruptcy of the buyer, to stop the

goods before they come into the buyer's possession. A factor either at home or abroad, if he consigns goods to his principal by the order of the principal, and has the goods in his own name or on his own credit, has the same right of stoppage in transitu as if he were the seller.

Difficult legal questions have arisen in respect to transitu. Generally speaking, the goods are in transit when they are not in the actual possession either of the buyer or of the seller. But the law goes sometimes further than this, and inquires into the constructive possession; for the goods may be in the actual possession of the seller, and yet so far constructively in the possession of the buyer that the seller cannot retain them; or they may be in the actual possession of the buyer, but under such circumstances that the seller's right is not taken away. It becomes, therefore, very important in many instances to ascertain whether the transit is complete. A carrier of goods, by land as well as by sea, acquires a lien on the goods which he carries for the freight money. The goods are still in transit, and may be stopped, so long as the carrier withholds them from the buyer by his lien for the freight, and a seller who seeks to stop them then must discharge this lien. In general, whenever a carrier enters into a new arrangement with the consignee, by which he agrees to hold the goods as the property of the consignee and at his disposal, there is a termination of the transit. Yet all acts in reference to such question must be open to explanation by existing circumstances, the general inquiry in such case being whether the carrier, warehouseman, wharfinger, or other person having actual possession of the goods at the time of the intended stoppage in transitu, was then acting as the agent of the seller or of the buyer; for if of the latter, the transit was terminated. If the buyer order the goods to be sent to some other person by any suitable conveyance without designating any one especially, or by a designated carrier who is not specifically his agent or servant, the goods remain in transitu until they reach that second person. Questions of constructive possession arise very frequently in respect to goods in the charge of warehousemen. In general, every warehouseman is the agent of any party who puts the goods in his warehouse and can take them out at his pleasure, and therefore his possession is the possession of such party. On this point it is a material question whether anything remains to be done by the seller; if nothing, this goes far to make the warehousing a delivery to the buyer. If a seller of goods that are warehoused delivers an order for them to a buyer, this alone may not transfer the possession; but if the buyer delivers the order to the warehouseman, this in general transfers the possession, and still more so if the warehouseman enters the same in his books or otherwise accepts the order, so as to be responsible for the goods to the buyer. If the buyer sells to a third party, to whom the warehouseman certifies that the goods are transferred to his account, and who thereupon pays the price, the warehouseman becomes responsible to this third party; and if the original seller, though there remained something material to be done by him to the goods, consented to the warehouseman's so certifying, he would be held to have lost his right of stoppage in transitu. The effect of a bill of lading upon the right of a seller to stop the goods in transitu is very important. The law regards the bill of lading, not as a mere receipt which the carrier gives for the goods, but rather as a muniment of title, carrying property with it, and being itself *quasi* negotiable. An indorsement and delivery of the bill for value operate as a symbolic delivery of the goods mentioned in it. It results from this doctrine that a consignee, who sells for value goods to arrive and indorses over the bill of lading, confers upon the purchaser a title and property which destroy the right of the seller of the goods to stop them in transitu. But if the party buying from the consignee knows that the sale is in fraud of the original seller, it is voidable by that seller; and if he knows that the consignee is, or is about to become, insolvent, this knowledge would probably have the same effect, as would also knowledge or notice of any circumstances which rendered the bill of lading not properly assignable. If the bill of lading be transferred and indorsed by way of pledge to secure the consignee's debt, the consignor does not lose entirely his right to stop the goods, but holds it subject to the rights of the pledgee; that is, he may enforce his claim to hold the surplus of the goods after the pledgee's claim is satisfied, and he holds this surplus to secure the debt of the consignee to him.

The insolvency of the buyer, however complete or however manifested, will not operate of itself as a stoppage in transitu. The goods must be actually stopped, in some way which the law recognizes as adequate, by the seller or his authorized agent. An actual taking possession by the seller is not necessary, at least not in all cases, although actual possession should be taken if possible, and as soon as possible. A constructive possession may be acquired by giving notice to the carrier or warehouseman, forbidding him to deliver the goods to the buyer, and requiring him to give them up to the seller or his agent, or to hold them subject to his order. Delivery in disregard of this notice does not defeat the seller's right; he has still a constructive possession, and the carrier is responsible to him for all the injury he may sustain. Or if the buyer becomes insolvent, and the goods pass into the possession of his assignees, the seller may maintain an action of trover against them. What the consignor may do personally, he may do by his agent; and if the demand be made by one who acts as agent, but without authority, a subsequent adoption and ratification will have the effect of a previous authority, provided this be made before the goods are demanded by the buyer.

In Scotland the doctrine of stoppage in transitu is similar to the law of England in its practical operation. It was introduced into the law of Scotland by a judgment of the House of Lords in 1790.

STOPPED PIPES. See ORGAN PIPES.

STORA'CE, STEPHEN, a musician, a native of England, though his father was a Neapolitan, was born in 1763. When young he was placed in the conservatory of St. Onofrio at Naples. On completing his education he made an extensive European tour in company with his sister, the celebrated Signora Anna Storace, when they both obtained an engagement at the Imperial Italian Theatre at Vienna, for which Storace composed an opera on the subject of Shakespeare's "Comedy of Errors," under the title of "Gl' Equivoci," much of the music whereof the author afterwards transferred to his English operas. In 1787 they returned to England, and were immediately engaged at the King's Theatre; but intrigues soon drove away a man who had too much honesty and ability to employ himself in combating jealousy and low cunning, and Storace never again could be persuaded to take any part in the affairs of that establishment. He therefore devoted his talents to Drury Lane Theatre, where he produced "The Siege of Belgrade" (altered from "La Cosa Rara"), "The Haunted Tower," "Pirates," "Lodoiska," &c.; and set the music to Colman's "Iron Chest," at the first rehearsal of which he caught a cold that terminated his life on the 19th March, 1796. The opera of "Mahmoud," then nearly completed, was brought out a few days after his decease for the benefit of his widow, and with the greatest success. Storace was a highly gifted and an able man. "Had Stephen," said Sheridan, "been bred to the bar, nothing could have prevented his becoming lord-chancellor."

STORAGE BATTERIES, reservoirs of electrical force, such as the Faure accumulators, the Ritter and Planté batteries, &c. See BATTERY, ELECTRIC.

STO'RAX is a fragrant gum resin, obtained from the bark of *Styrax officinale*, a native of the countries bordering on the Mediterranean. This tree belongs to the order STYRACEÆ. The storax is obtained by stripping off pieces of the bark, and submitting them to pressure. It is composed of an aromatic resin, combined with a volatile oil (styrol or cinnamene) and an acid (cinnamic acid). It has a fragrant odour and an aromatic taste, and was used

Storax (*Styrax officinale*).

medicinally as a stimulating expectorant as well as by perfumers. True storax is not met with now, the storax of commerce being obtained from *Liquidambar orientalis*, a native of Asia Minor. [See LIQUIDAMBAR.] An allied species, *Styrax benzoin*, yields the fragrant resin called BENZOIN or Benjamin. See GUM-RESINS.

STORCH, NICOLAUS, one of the leaders of the Anadaptists, was born at the end of the fourteenth century at Stolberg in Saxony. Of no great learning, but of an insinuating manner, he had irresistible influence over vulgar minds. He embraced the principles of the Reformation, and soon distinguished himself as the advocate of sweeping social and theological changes. He opposed the baptism of infants, proscribed as dangerous the study of the Fathers and councils, interdicted, in short, all literature. By God alone, so he taught, could we be so enlightened as to distinguish truth from error. Luther obtained an edict of banishment from the Elector of Saxony against Storch. He went to Zwickau, where his principles spread rapidly. They were also widely propagated in Thuringia, Swabia, and Franconia. Some of them, such as his doctrine of communism, struck at the very root of society. Munzer, an associate of Storch, a man of no great prudence, excited the peasantry to rebellion; but the fanatics were defeated by Count Mansfeld. Storch fled to Silesia, and was afterwards banished. He then went to Poland, where he founded a sect. Compelled to flee, he sought an asylum in Bavaria, where he died, 1530.

STORIO'NI of Cremona, who flourished in the latter half of the eighteenth century, is noteworthy as the last maker of the fine Cremona violins. With him the genuine Cremona tradition, the undiscovered secret, whatever it may have been, was buried, in the first years of the present century. Fine instruments by Storioni are found dated 1801, whilst the full excellence of his violins begins as early as 1756. He seems to have been a pupil of the great Joseph Guarnerius (died 1745).

STORK (Ciconia) is a genus of wading birds (Grallæ), the type of the family Ciconiidæ. In this genus the bill is long, straight, strong, and pointed; the nostrils are slit longitudinally in the horny substance of the bill, near its base; the eyes are surrounded by a naked skin. The legs are long, the toes are short and stout, the three anterior being united by a membrane up to the first joint; the claws are short, broad, and blunt. The wings are moderate, and the tail is short and slightly rounded.

The White Stork (*Ciconia alba*) is an irregular visitor to Britain, though common in some parts of the continent of Europe. It breeds in Holland, Sweden, Denmark, through Central Europe to Turkey and South Russia and Asia Minor. The winter is passed in the warmer parts of Asia and Africa, its range extending in the latter continent to Cape Colony. It breeds to some extent in Palestine, but is far more numerous in that country on migration. The white stork is a large bird, about 3½ feet in length, while the bill measures about 8 inches. Its plumage is white, with the quills and greater wing-coverts black; the legs and bill are red, and the bare skin round the eyes black.

The stork frequents marshes and the banks of rivers, and feeds on reptiles, frogs, fish, aquatic insects, worms, small mammals, and birds; it also devours carrion and other offal. These birds migrate in large flocks, and their departure is signalized by the great noise created by the clattering of their bills. Their flight is powerful and high in the air.

Assured by the kindness with which it is treated in requital for its services in clearing the land of dead as well

White Stork (*Ciconia alba*).

as living nuisances, the white stork approaches the dwellings of man without fear. In Holland and Germany, especially, the bird is treated as a welcome guest, and there, as indeed elsewhere, it annually returns to the nest which has cradled many generations, on the steeple, on the turret, on the false chimney that the Hollander has erected

for its site, in the box, or on the platform which the German has placed for its use. The nest is generally placed on buildings, but the stump of a decayed tree or a ledge of the cliff is sometimes chosen by the bird, and the nest is made of sticks and twigs, on which are laid from three to five cream-coloured or yellowish-white eggs, about the size of those of a goose. The incubation continues for a month, at the expiration of which period the young are hatched and carefully attended to by the parents until they are fully feathered and able to procure food for themselves. In the continental towns domesticated storks, which have been taken from the nest when young, may be often seen parading about the markets, where they are kept as scavengers to clear the place of the entrails of fish and other offal, which they do to the satisfaction of their employers. From its care for its young, the stork had a high reputation among the ancients for piety, was generally unmolested, and in some places even made an object of worship.

The Black Stork (*Ciconia nigra*) is another European species, of which a few specimens have been taken in England. Its distribution is very similar to that of the white stork, but it ranges further west in Asia in winter. Unlike the white stork it shuns the society of man, frequenting the most sequestered spots, and building its nest on forest trees. It is about the same size as the preceding species, and is of a deep black colour, with purple, copper, and green reflections; the under surface is white and the legs scarlet. There are several other species of storks.

STORMS (Ger. *sturm*), violent atmospheric commotions, also distinguished by the names of cyclones, tornados, hurricanes, and tempests. Notwithstanding the laborious research of modern physicists, it cannot be said that the causes or general laws of these phenomena have been accurately determined. It has been justly observed that to arrive at these principles it would be requisite to ascertain, in a great number of particular instances, the place and time of the beginning and termination of the storm, its direction and course, the extent of atmospheric perturbation which it produced, the force and velocity of the wind, and the barometric pressure at every part of the disturbed column during the whole time of its continuance. Several of these points, however, could only be determined from the comparison of numerous simultaneous observations on that tract of the globe's surface over which the tempest passes; while it is evident that in actual practice a few insulated records are all that can generally be obtained, especially as for the most part a storm sweeps over some portion of the sea where, unless a ship should be caught in it, no observation can be made, and no proof of its existence obtained. Nevertheless, as meteorological science progresses and its importance becomes more generally recognized, we may hope that a greater number of data will be collected which may not improbably lead eventually to some satisfactory solution of the problem.

The usual *shape* assumed by a storm, or by its area, has been found to be either circular or slightly elliptical. When elliptical the major axis of the ellipse is about twice the length of the minor axis, though occasionally a greater elongation has been observed. The extent over which a storm spreads its influence necessarily varies, but it is seldom less than 100 miles in diameter. The area varies in size daily, now expanding and now contracting. When the area contracts it may be assumed that the storm is spending its force, and its central depression filling up when it expands, not only will this central depression increase in depth, but often the storm will break up into two or three depressions, each forming a separate storm with the wind revolving round it.

As it is in the Torrid Zone that the most furious tempests occur, and as in the northern latitudes they are both less violent and less frequent, in the polar regions seldom mounting to more than a strong wind, it may be presumed that a connection exists between these atmospheric convulsions and the velocity of the earth's surface, which is greater at the equator than at the poles.

That storms travel in a *direction* opposite to that of the wind which prevails at the time they are raging, was first observed by Franklin. The direction therefore differs in different regions, being necessarily regulated by the prevailing winds. In Northern and Central Europe nineteen out of every twenty, it is said, travel toward some point from the north-east to the south-east, and it has been found that the major axis of the storm almost always corresponds with the direction of its apparent movement. It must not be supposed that the same direction is preserved daily during the continuance of the storm. The divergence usually small, but there are occasions when it is as great as it is sudden. The storm that swept over Europe in December, 1863, broke out on the west of Ireland, then shifted east to Liverpool, wheeled southward to Cherbourg, returned north to Shields, and crossing to Copenhagen, finally expired in the Baltic Sea. Most of the North American hurricanes rise in the west, and cross the Rocky Mountains to spend their volume on the United States, occasionally traversing the Atlantic, and bursting on the western coast of Europe. In the West Indies they originate near the Region of Calms, and veer from north-west to north-east, afterwards skirting the eastern coast of America as far as Nova Scotia. In the Indian Ocean and South Atlantic they sweep towards the south-west, and then gradually shift round to the south-east. In the Chinese Seas, north of the equator, their course corresponds with that of the tempests of the West Indies. In Hindustan, after traversing the east coast, they veer to the north-west, and ascend the valley of the Ganges.

With respect to the *velocity* of storms no certain rules can be laid down. Some travel at as low a rate as 15 miles an hour, others at 20, others at 30. In Europe the average rate is between 16 and 17 miles; in the tropics, nearly 40.

The *prognostications* of an approaching tempest are barometrical. As the barometer falls the temperature rises, and as the barometer rises the temperature falls. When the barometer has been falling for some time the sky grows overclouded, and rain descends at intervals. Gradually the sky becomes darker, the rain heavier and more constant, and the wind increases in violence, until the central depression has passed over the observer's locality; then the wind begins to moderate, the rain grows less heavy, breaks up into showers, and finally ceases, while the clouds vanish and reveal once more the bright face of a serene heaven. The quicker and more complete the barometric fall, the heavier will be the rainfall; and if, after a storm has passed, the temperature rises rapidly and markedly, a second gale may be expected.

The theory on which these atmospheric phenomena are now generally explained is called the *rotatory*. It supposes that the storm revolves round an axis either vertical or inclined to the horizon, while its body has a simultaneous progressive motion over the earth's surface; the barometric depression, produced by the centrifugal force of rotation, driving the air from the centre to the circumference of the storm.

To a spectator placed at the centre the direction of the rotation is from *right* to *left*. This is true, however, only in the northern hemisphere; in the southern it is reversed, and the rotation is from *left* to *right*.

On the whole, then, the following *general data* appear to be conclusively established:—(1) The most violent hurricanes originate in tropical latitudes to the north or east of the West Indian Islands. (2) They simultaneously cover a superficial area varying from 100 to 150 miles in diameter, their violence diminishing towards its exterior

and increasing towards its interior. (3) They do not move in a straight line. South of the parallel of 30° N. lat. they proceed in a westerly course inclined to the north; but when arriving near this parallel they change rather abruptly to the north and east, and continue to incline gradually more to the east. The average progressive velocity varies from 15 to 40 miles an hour. (4) Their duration at any particular place depends, of course, on the extent of the mass of agitated air and the progressive velocity. Storms of small extent move much more rapidly than those which occupy a large area. (5) The direction of the hurricane is not that of the wind. If the former were progressively westward the wind at the commencement will blow from a northern quarter, and during the latter part of the gale from a southern quarter of the horizon. If the progressive motion be eastward the wind blows at first from a southern, and towards the termination of the storm from a northern quarter. Remarkable success has been gained of late years in predicting storms, as a result of these carefully ascertained general principles. Their gradual approach from the west is chronicled, and by the time they burst upon our shores their extent and force has been so discounted that vessels have been able to get into safety, and scarcely any damage occurs. See the section *Weather Telegraphy* in the article METEOROLOGY.

STORMS, MAGNETIC. Observers frequently record that a sudden (often minute) irregular disturbance will affect the whole of the compass needles over a considerable region of the earth. Such occurrences are known as magnetic storms. Powerful groups of examples occur during periods of maximum sun-spots, that is, about every eleven years; and severe magnetic storms affecting the needles over very large areas, indeed, always accompany the appearance of the aurora borealis to any marked extent. This fact, coupled with the position of the auroral streamers with regard to the magnetic meridian, suggest irresistibly the electrical nature of this mysterious light, but as yet no exact knowledge has been obtained. Auroræ tend to occur in greater numbers during maximum sunspot periods. In the noteworthy magnetic storm of 1st September, 1859, when auroræ were observed all over the globe, and when the sun was extraordinarily active, no development of electricity could be discovered in the atmosphere.

STORNEL'LO, a kind of short poem of three-rhymed eleven-syllabled lines, peculiar to Tuscany, where it is improvised with astonishing felicity. Sometimes the first line of the stornello has only five syllables. The word is a corruption of *ritornello*, alluding to the repeated rhymes. The rhyme-scheme is indeed beautifully simple, yet subtle; the first and third lines have double rhymes, the middle line rhyming also with the last, but not with the preceding, syllable. We may take one of the stornelli from Tigri's "Canti populari Toscani" (Florence, 1869), as a specimen of these graceful triads:—

> "Tutta la notte in sogno mi venite;
> Ditemi, bella mia, perche lo fate;
> E chi viene da voi quando dormite?"

STOR'NOWAY, a seaport and chief town of the Outer Hebrides, situated in the island of Lewis, in the county of Ross, at the head of a loch, with a good harbour, 180 miles north-west by steamer of Oban. The present prosperity of the town has been greatly increased by allusions to it in Black's novels and the energetic efforts to improve the town and enlarge its trading facilities. It now has a public hall and library, court-house, customhouse, and two Free churches, and an Established, U.P., and Episcopal church. The entrance to the harbour is well lighted, and there is a good quay and patent slip. The chief industries are fishing and fish-curing. The population in 1881 was 2627.

STOR'THING (from the Norse *stor*, great, and *thing*, court), the Norwegian Parliament, said to have been first summoned by Haco V. in 1223, at Bergen. Its members (seventy-five to a hundred in number) are elected once in three years by certain deputies, who are chosen, in the first place, by a constituency consisting of every native Norwegian not under twenty-five years of age, who is a burgess of any town, and possesses property or the life-rent of land to the value of 500 kroner, or in the towns 800 kroner, respectively £27 and £43. Each deputy must possess the same qualification. During the sitting of the Storthing the members receive an allowance of about 6*s.* 6*d.* per day. It meets annually, without any writ from the king, and divides itself into two chambers, the *Lagthing*, composed of one-fourth, and the *Odelsthing*, of three-fourths of the members. The king has a veto over decisions of the Storthing, but can only exercise it twice. At the third resolution of the Storthing the law must pass.

STORY, JOSEPH, LL.D., an eminent American lawyer and judge, was born on the 18th September, 1779, at Marblehead, in the state of Massachusetts. He received the rudiments of learning in his native town; entered Harvard University in 1795, and took a degree there in 1798. In 1801 he was called to the bar, and speedily obtained extensive practice. In 1805 he became a member of the legislature of Massachussets, and he continued a representative till, in November, 1811, he was appointed an associate justice of the Supreme Court of the United States. The jurisdiction of this court, both original and appellate, embraces a very great variety of subjects; and Story was thus led to consider the complicated questions of international law. The result of his practical experience was his "Commentaries on the Conflicts of Laws," published in 1834, which gained him a reputation in Europe. In 1830 he was appointed to the newly-founded chair of jurisprudence in Harvard University, and during the time that he held it wrote his numerous legal treatises: "On the Law of Agency;" "On the Law of Partnership;" "On the Law of Bills of Exchange;" "On the Law of Bailments;" "On Equity Jurisprudence;" and "On Equity Pleadings." The last is founded on Mitford's work, of which large portions are actually incorporated. He died 10th September, 1845. His "Life and Letters," by his son W. W. Story, appeared in 1851, and a collected edition of his "Miscellaneous Works" in 1852.

STOTH'ARD, THOMAS, R.A., was born in Long Acre, London, on the 17th of August, 1755. His father, who died when Stothard was young, was landlord of the Black Horse in that street. Stothard was early apprenticed to a silk pattern-designer, but meeting with no encouragement he took to drawing for the booksellers—a department of art in which he became eminently successful. In 1778 he became a student of the Royal Academy, and in the same year he exhibited a picture of "The Holy Family." He continued to combine the occupation of book illustrator and painter for many years. He became an associate of the Academy in 1791, and R.A. in 1794. In 1813 he succeeded Burch as librarian. He died at his house in Newman Street on the 27th of April, 1834, in his seventy-ninth year. Stothard gained more reputation by his illustrations than by his pictures, which, though richly coloured and very gracefully composed, are also often very ill drawn; he trusted too much to memory, his habit of making his small drawings leading him to work without the assistance of models. His designs are very numerous, about 3000 being engraved in various publications.

STOUR'BRIDGE, a market-town of England, in the county of and 20 miles N.N.E. from Worcester, and 142 north-west from London by the Great Western Railway, stands on the south side of the Stour, over which there is a stone bridge, forming the communication with Staffordshire, and on a branch from the Worcester and Stafford

Canal. The town is rather irregularly built on a gentle declivity, but its general appearance is handsome. The market-house is a spacious modern structure. There are two churches. There is a free grammar-school, founded by Edward VI., and rebuilt in 1862, in which Dr. Johnson received the rudiments of his education; various other schools, a Roman Catholic church, and places of worship for dissenters. The town has also a corn exchange, a county court, Italian in style, built in 1864, a mechanics' institute, and a school of art. The manufactures consist chiefly of nails, iron, glass, and fire-bricks made of the Stourbridge clay, which will bear a great heat. It is for this reason that it is used in crucibles, glass-house pots, &c., and its value in this respect is so well known abroad that it forms an important article of exportation. The clay occupies an area of about 200 acres near the town, the best being found at a depth of 150 feet below the surface. The population of the town in 1881 was 9757.

STOUR'PORT, a market-town of England, in the county of and 12 miles from the city of Worcester, is situated in the parish of Kidderminster, in the angle formed by the confluence of the Stour with the Severn. The Stafford and Worcester Canal, which communicates with Dudley, Stourbridge, and Kidderminster, also enters the Severn at this place. There is an extensive basin with wharves and warehouses for the accommodation and as a general depot of the trade in heavy goods between the west and central portions of the kingdom. The houses are mostly built of brick, and the general appearance of the town is neat and thriving. It has a church, Wesleyan chapel, tanyard, carpet factory, &c. The iron bridge over the Severn consists of a single arch of 150 feet span. The population in 1881 was 3358.

STOW, JOHN, a celebrated English antiquary, was born in London about 1525. In the early part of his life he followed the trade of a tailor. He had probably from early life a taste for the investigation of the national antiquities; but it was not until his fortieth year, as we learn from himself, that he left his business and applied himself altogether to his favourite study, for which purpose he travelled on foot through the greater part of England. The accounts that have been given of his publications are for the most part very defective, confused, and contradictory. It does not appear that there are really more than two of his historical works extant, his "Summary" and his "Annals," and one topographical work, his "Survey of London." The earliest edition of the "Summary" that is known is a very small 18mo volume, in black letter, entitled "The Summarie of Englishe Chronicles (lately collected and published), abridged and continued till this present Moneth of November, in the Yeare of our Lord God, 1567, by J. S.; imprinted at London, in Flete Street, nere to S. Dunstone's Church, by Thomas Marshe." But this is not the first edition of the book, as is stated by the author in a dedication to the lord mayor, aldermen, and commoners of London. The "Annals" appear to have been first printed in 4to and in black letter, in 1592, to which year the history is brought down. Another edition, also in 4to and black letter, is entitled "The Annales of England; faithfully collected out of the most authentical authors, records, and other monuments of antiquity; lately collected, since increased, and continued from the first habitation until this present year 1605; by John Stow, citizen of London. Imprinted at London for George Bishop and Thomas Adams."

Stow's other work, his "Survey of London," was first published, in a quarto volume, in 1598; and has been frequently reprinted, with additions. Stow, in various passages of his "Annals," claims the continuation of Holinshed's "Chronicle" from 1576 to 1586 as his own handiwork. He appears to have at least supplied a great part of the materials for that portion of the work. The hard fate of Stow in his old age is well known. The laborious and acute investigator of antiquity, and faithful and graphic depictor of the manners and customs of his own time, was left by his countrymen, when he had reached his eightieth year, literally to beg his bread. Strype has given a letter from James I., referring to letters patent under the great seal, granted 8th of May, 1603, authorizing Stow, in consideration of his public services, to collect the voluntary contributions of the people throughout the greater part of the kingdom. He died, 5th April, 1605.

STOWE, HARRIET BEECHER, the author of "Uncle Tom's Cabin," was born about 1812, at Lichfield in Connecticut. Her brother, the Rev. Henry Ward Beecher, became one of the most popular American preachers and lecturers on literature. (He died March, 1887.) Their father, Dr. Lyman Beecher, who, by the most honourable exertions, had raised himself from a blacksmith's shop to a position of high repute as a Presbyterian minister, was in 1832 made principal of the Lane Seminary, established for theological students of that persuasion in Cincinnati. Miss Beecher, who had assisted an elder sister in the management of a school at Hartford, accompanied her father to his new place of abode, and in due course of time married the Rev. Calvin E. Stowe, professor of biblical literature at the seminary. Her first literary achievements were short religious stories written to promote schemes of benevolence. In 1844 she had advanced a step further by the publication of "The Mayflower, or Sketches of Scenes and Characters among the Descendants of the Pilgrims." The seeds of that enthusiasm for the abolition of slavery, to which she owes her great fame, were early sown in her mind by her father, and were fostered by her husband. The Lane Seminary became a focus of anti-slavery agitation, and for a certain period there was imminent danger of a violent attack from the mob. The result of this agitation was the breaking up of the college, and the removal of Mr. Stowe and his wife to the theological seminary of Andover, Massachusetts. It was in the year of this removal (1850) that Mrs. Stowe began the story which did more in a few months towards the discomfiture of the slavery party than all the labours of all the students and professors of Lane Seminary could have done in years. "Uncle Tom's Cabin" was published, chapter by chapter, in a weekly periodical entitled the *Washington National Era.* On being completed the tale was reprinted, and went rapidly through several editions. It has been stated that 200,000 copies were sold in the United States. This extraordinary sale emboldened an English publisher, regardless of the claims of copyright, to bring out an edition. At first the work was coldly received, and was condemned as repulsive in its horrible details. But ere long the singular dramatic power displayed in the creation of Topsy, the pathetic description of Uncle Tom, and even the coarse handling of Legree's brutal character, procured for the book a degree of popularity almost unexampled in literary history. To those who disputed the truth of her positions in the story Mrs. Stowe replied by the publication, in 1852, of a "Key to Uncle Tom's Cabin"—a statement of the facts upon which she had founded her narrative. Her travels in England, Scotland, and various parts of the continent of Europe, published in 1854, she entitled "Sunny Memories of Foreign Lands." In 1856 she published a more ambitious and elaborate story illustrating slave life, "Dred;" and in 1862 "Agnes of Sorrento," a tale of Italian life. In 1869 she contributed to *Macmillan's Magazine* an article—"The True Story of Lord Byron's Life"—charging Lord Byron with incest. This article shocked the public sense of fairness and decency, and evoked from many quarters a storm of indignant comment which was kept up for a time by the publication in 1870 of "Lady Byron Vindicated." Mrs. Stowe has produced many other works besides those mentioned.

STOWELL, WILLIAM SCOTT, BARON, a distinguished English lawyer, was the elder brother of Lord Chancellor Eldon, and the eldest son of Mr. William Scott, of Newcastle. He was born 17th October, 1745 (O.S.), at Heworth, in Durham. He was educated at the royal grammar-school of Newcastle, from whence he removed to Corpus Christi College, Oxford, in 1761. In 1764 he was elected a probationary fellow of University College, and succeeded William (afterwards Sir William) Jones as college tutor. In 1772 he took his degree of B.C.L., having determined on following the profession of an advocate at Doctors' Commons. He was already a member of the Middle Temple, London.

In 1774 he was elected Camden reader of ancient history, in which capacity he delivered lectures to a crowded audience. He resided at Oxford, where he took his degree of D.C.L., until 1779, and was called to the bar in 1780. His talents and learning, and the reputation he had brought from the university, soon brought him a large practice in his profession. His success as an advocate in no long time led to promotion. In 1783 he was appointed to the office of registrar of the Court of Faculties. In 1788 the Bishop of London appointed him judge of the Consistory Court; and the Archbishop of Canterbury, his vicar-general or official principal. In the same year he was made advocate-general and knighted, and was also nominated a privy councillor. In 1790 he was nominated by the archbishop master of the Faculties. Finally, in 1798, he was made judge of the High Court of Admiralty. In 1801 he obtained the great object of his ambition, by being elected member for the University of Oxford, and he retained his seat as long as he was a commoner. He was made a peer in 1821, being created Baron Stowell, of Stowell Park. He retained his place on the bench till Christmas, 1828. For the last two years of his life he was reduced to a state of mental imbecility; and he died at his seat of Early Court, Berkshire, after an illness of a few days, 28th January, 1836, in his ninety-first year.

Lord Stowell is the highest English authority in his own department of the law, including both ecclesiastical law and the law of nations. His judgments in the Consistory Court were reported by Drs. Haggard and Phillimore; those delivered by him in the Court of Admiralty, in part with the advantages of his own revision, by Drs. Robinson, Edwards, Dodson, and Haggard. Their characteristics are the most complete mastery of all the learning of his subject, great comprehensiveness of view, a penetrating sagacity in the disentanglement of the essential points and governing principle of a case from the confusion and sometimes apparent contradiction of details and accessory circumstances, a remarkable faculty of luminous and striking illustration, and all this combined and set off with a diction generally of much precision, elegance, and expressiveness, though somewhat diffuse and rhetorical.

STOW'MARKET, a market-town of England, in the county of Suffolk, 12 miles north-west by north from Ipswich, and 80 miles from London by the Great Eastern Railway, is situated on the Gipping. The town has been increased and improved, and some of the houses are of a superior character; the church is a handsome structure in the Decorated and Perpendicular styles, which was restored in 1867. The other chief buildings are a Roman Catholic Church, Independent chapel, corn exchange, and a Literary Institute. Leather, paper, iron, cordage, sacking, chemicals, and agricultural implements are manufactured in the town, and a considerable import and export trade is done in timber, deals, coal, slate, corn, and malt. The largest manufactory of gun cotton in England is situated here, and was in 1871 the scene of a terrible and fatal explosion. The works were rebuilt in 1873, and every precaution adopted to insure the safety of the manufacture and storage. The population in 1881 was 4052.

STRABANE, a market-town of Ireland, the capital of the county of Tyrone, 18 miles N.N.W. from Omagh, and 130 miles by railway from Dublin, consists of a number of streets irregularly built on the north-east bank of the Mournes a little above the junction of the Finn. The town is situated in a fine valley, inclosed by lofty mountains, and is on the railway from Enniskillen to Londonderry. A bridge over the river connects the town with a small suburb on the opposite bank, in the county of Donegal. The houses are generally well built, and many of them handsome. There are two Protestant churches, a Roman Catholic church, two Presbyterian churches, and two Methodist meeting-houses, a sessions house, union workhouse, and St. Joseph's Convent of Mercy, and industrial schools. Green fruit, salt-beef and pork, butter, eggs, and poultry are exported; and timber, staves, iron, groceries, and general merchandise are imported. The manufacture of linen and the business of bleaching are carried on very extensively in the town and neighbourhood, a number of excellent houses and shops have been recently erected, and the town has a thriving appearance. On the Foyle, below the town, is an important salmon fishery. Trade is facilitated by the Strabane Canal, connected with the Foyle, the basin of which is adjacent to the town, and has good wharfs and quays. The population in 1881 was 4196.

STRA'BO, the geographer, was born at Amasia, in Pontos, about 66 B.C. He was of a distinguished and wealthy Cappadocian family, and his ancestors claimed kindred with the great Mithradates. He received an excellent education after the Greek fashion, and as he inherited a considerable property he was able to indulge his taste for travel, and spent much of his long life in visiting foreign countries. Though not perhaps profoundly learned, he was extremely well informed; in philosophy he embraced the tenets of the Stoics. As to the countries which he had seen he tells us that he had travelled from Armenia on the east to Sardinia on the west, and from the Euxine on the north to Ethiopia on the south. The countries with which his personal acquaintance was most intimate seem to have been his native soil, Asia Minor, Italy, and Egypt. In Italy he lived for some time, mostly at Rome. He traversed the whole of Egypt, and visited the cataracts of the Nile. His death took place about A.D. 24, at the age of at least ninety years. Strabo's great work is a geographical description of the ancient world, comprised in seventeen books. It was of course to a considerable extent based on the labours of his predecessors, especially on that of Eratosthenês, who lived about 300 years earlier. Strabo's object in composing this remarkable book was not merely to give an accurate geographical view of the world as then known, but also to afford valuable political information as to the previous history of the countries which he describes. Hence arises the great value of the work at the present day. His mathematical and astronomical knowledge, though considerable, was not of the highest order, and occasionally betrays him into error. These, however, are but slight blemishes in so laborious and valuable a work, which is certainly our most reliable authority for the geography of the ancient world. Among the countries treated of are Spain, Britain, Ireland, Thulè, Italy, Greece, Asia Minor, Persia, Arabia, Egypt, Ethiopia, Libya, and India. Besides the knowledge derived from his own travels and the works of his predecessors, Strabo had access to the best contemporary information. Thus we find that for his account of Arabia he consulted his friend Ælius Gallus, who had led a Roman army into those barren deserts. The best editions of Strabo are those of Koray (Paris, 1818), and of Kramer (Berlin, 1844). An excellent English translation of Strabo was produced in Bohn's Library in 1854. The word Strabo means "The Squinter," but such personal surnames were as often inherited as acquired.

STRADEL'LA, ALESSANDRO, the musical composer, is supposed to have been born at Naples about 1645, and to have been murdered at Genoa in 1678 or the following year. He seems to have been a very accomplished musician, playing several instruments, &c. His oratorio or sacred drama of "St. Giovanni Battista" is a work greatly in advance of its time; it is supposed to have been written in 1676. A copy of it is in the library of the Sacred Harmonic Society. The opera of "La Forza dell' Amor paterno" was printed at Genoa in 1678, with the dedication by the composer, and with an advertisement which speaks of him as then living and as held in the highest esteem. This latter seems to have been the only composition of Stradella that was printed during his life, but besides these he wrote numerous cantatas for a single voice (alternations of air and recitative), smaller songs, duets, trios, and madrigals for four and for five voices, several of which are preserved in the library of the British Museum, in the Bodleian Library at Oxford, in the Imperial Library at Paris, and in the library of the Conservatorio at Naples. The exquisite *aria di chiesa,* "I miei sospiri" (or "Pieta Signor"), familiar in our concert rooms, and attributed to Stradella, is now generally thought to be of much more modern origin. While he was composing operas for the signory in Venice a nobleman intrusted him to give singing lessons to his mistress. Stradella and the lady, Ortensia by name, became mutually enamoured, and eloped together. The nobleman hired two bravos to follow and assassinate them. The lovers were traced, after some time, to Rome, where Stradella was about to produce an oratorio at the church of St. Giovanni Laterano. The murderers attended the performance, purposing to waylay the composer and the lady as they quitted the church. Their hearts were so touched by the music, however, and by the exquisite singing of Stradella, that they were incapable of fulfilling their vengeful task, but rushed up to him and confessed the errand on which they had been sent. Stradella instantly departed with Ortensia for Turin, where the Duchess of Savoy, who was then regent, took them under her protection. The father of Ortensia, with two accomplices in the pay of the Venetian, attacked Stradella while taking his evening walk upon the ramparts; in sight of the multitude of promenaders, they wounded him severely, and fled into the Venetian ambassador's house, who refused to surrender them even on the demand of the duchess. Stradella recovered, and married Ortensia under the auspices of the duchess. A year passed by, and he then went to Genoa to produce his opera. Thither the ruthless father of his wife, with his two associates, was despatched by the Venetian noble; the three surprised Stradella and Ortensia in their chamber, accomplished their deadly purpose, and escaped by means of a vessel which was lying ready to secure their flight.

STRADIVAR'IUS, ANTONIUS (*Stradiuarius*, as he usually wrote it), was the Latinized name adopted, according to the fashion of his day, by the greatest maker of violins who ever lived, Antonio Stradivari. He was born in 1644 at, or near, Cremona, where his name has always been locally common and is still well represented. He early entered the workshop of old Niccolo Amati, the finest violin-maker of his day. He was married at twenty-three to a widow somewhat his senior. When Amati left off business Stradivari took over all his patterns, &c. He had already set up his own workshop, but still worked strictly on the Amati plan, and while they are perfect instruments they present none of that unrivalled excellence in both tone and form which quickly began to mark his work when he had thrown off the leading-strings of his master.

In 1680 Stradivari was established in business for himself, in his own house on the Piazza San Domenico (now No. 1 Piazza di Roma). This house was let at his death to the famous Bergonzi, whose violoncellos are so greatly esteemed. It is interesting to note, among the crowned heads from whom Stradivari now received plentiful orders, our own King James II., who had a viol da gamba from him in 1686. By 1690 Stradivari had fully developed the form of his own violin model (one of his 1689 instruments sold for £760 in Paris in 1887), and a little later on he attained the consummate excellence of tone which he alone has achieved. From that time on to 1736, when, at the age of ninety-two, he made his last fiddle, he sent out in a continuous stream those priceless productions which have ever since given the greatest pleasure to the lover of fine sounds which can possibly be obtained from any medium, save the human voice. We have called them priceless, and the adjective is not undeserved, for his violins of the finest period, when well preserved, fetch £1000 and thereabouts. The violins of his last ten years are less esteemed than the rest. The famous "Betts Strad," date 1704, was sold to a wealthy amateur for £1500 in 1885, by Mr. Hart, the well-known dealer, who had given 800 guineas for it to the famous violin-maker Vuillaume of Paris, in 1878. Old Betts, a well-known violin maker and dealer (of the Royal Exchange), bought it about 1830 of a footman, who brought it casually to his shop to sell, and was glad to get one sovereign for it. When Betts had authenticated it, its price grew at every resale, until it has now reached the almost absurd amount above named. It is almost as fresh as if it had just left the maker's hands, which renders it of unusual value. When M. Vuillaume first had it, in 1858, it had the original bass bar of Stradivari far too weak for our modern heavy strain.

Stradivari married again when fifty-four years of age, after mourning his first wife about a year; and his second wife was no less than twenty years his junior. He had five children by each marriage. Stradivari's life was quite uneventful, and was passed in unceasing devotion to his work. We can catch a glimpse of him as he lived at Cremona in 1730. Polledro, an aged chapel-master at Turin, describes "Antonius, the lute-maker," after the testimony of his teacher, Pugnani, who just remembered him as a child, as high, thin, and worn with incessant toil. In summer he wore a white cotton night-cap and a woollen one in winter. He was never without his work apron of white leather, and always to be seen with a tool in his hand. He worked without pause from sunrise to sunset. He never sought any change of occupation. His violins sold for four golden livres a-piece (equal to about £35 now), and were thought the best in Italy. He made a prodigious number of violins, lutes, guitars, and violoncellos. He was well versed in all forms of decoration, and an exquisite carver in wood. He saved a good deal of money, and the proverb passed in Cremona, "As rich as Stradivarius." His workroom may still be seen in what is now the Piazza Roma at Cremona. It is a mere loft at the top of the house, wide open to sun and air on two sides, and overlooking the roofs and hanging gardens of Cremona.

Stradivari died at the age of ninety-three, and was buried in the church of St. Domenico, in the chapel of "Our Lady," opposite his workshop, in the year of our Lord 1737. The church has now been pulled down, and the whole space is turned into a public garden. A street in Cremona is named Corso Stradivari, in honour of the great Cremonese.

Stradivari altered the Amati model by making it thinner, that is, containing less space from belly to back, and introduced many slight but all-important improvements in construction and form. Among other things he entirely remodelled the design of the bridge, lightening and beautifying it; and the effect of the alteration upon the tone is readily imaginable by violinists who have known the troubles of a clumsy bridge.

Stradivari is best known by his violins, but he made all

kinds of stringed instruments. Beautiful guitars with sound-holes full of delicate tracery, like a cathedral window, and exquisitely carved mandolines by his hand rejoice their possessors. But of all his numerous *viol-da-gambas* none have survived. His tenors (violas) are the least esteemed of his work; he has kept to his beautiful violin model, and has somewhat missed the peculiar tenor quality. His violoncellos often rise to that towering excellence which the violins of the fine period always attain. The finest Stradivari violoncellos are certainly the finest in the world, but as a class they vary considerably in tone. Of course the form and workmanship are always superb. The double-basses are rare, and are very highly esteemed.

Two of Stradivari's sons became good violin-makers, but did not rise above the ordinary level of good workmanship.

STRAFFORD, THOMAS WENTWORTH, EARL OF, a celebrated English statesman, was born in Chancery Lane, London, 13th April, 1593, being the eldest son of Sir William Wentworth, of Wentworth Woodhouse, in the county of York. He was educated at Cambridge, made the "grand tour" of Europe on leaving college, and before he was nineteen married a daughter of the Earl of Cumberland. At the age of twenty-one, by the death of his father he inherited the large and ancient family estate of Wentworth Woodhouse, and received the honour of knighthood. He sat for the county of York in the Parliament which began 5th April, 1614, and was afterwards elected for York in 1621, for Pontefract in 1624, and for York in 1625. In 1615 he was appointed to the office of custos rotulorum for the West Riding of the county of York, in the room of Sir John Saville. From his first entry into public life he seems to have desired employment in the service of the court, but being thwarted in this desire by the jealousy of Buckingham, he joined the Opposition, and came to be regarded as a supporter of the popular party. He was among the number of those whom Buckingham attempted to disable from serving in Parliament, by having them pricked sheriffs for their respective counties, and soon after was deprived of his office of custos rotulorum. In May, 1627, he was committed a prisoner to the Marshalsea by the lords of the council for refusing the royal loan; and after remaining there six weeks he was sent to Dartford, where he was obliged to remain until nearly the close of the year. When the third Parliament of Charles began, in which Wentworth sat for Yorkshire, he became one of the strongest and ablest advocates of the Petition of Right, but having attained his end, in making himself feared and courted by the king, he quickly deserted the popular side and became a leader of the court party. The Parliament came to an end in June, 1628, and in July Sir Thomas was created Baron Wentworth, being made shortly afterwards Viscount Wentworth, Lord President of the North, and a member of the Privy Council. His acceptance of the office of President of the North was a flagrant violation of the fundamental principle of the Petition of Right, and one of his first acts was to declare that he would lay by the heels any man who ventured to sue out a prohibition in the courts of Westminster. This was done, however, by Judge Vernon, who had the courage to resist such an encroachment on the ancient laws of the land, and Wentworth in return tried hard to remove the judge from his office. In January, 1631, he was made lord deputy of Ireland, and the principle on which he administered its public affairs was in substance the same as that of his government in the presidency of York. A clear-headed, strong-willed man, he had formed a plan for making the king an absolute monarch, thus doing for England what Richelieu was doing for France, and this scheme, to which he gave the name "Thorough," he was able to carry out successfully in Ireland. Starting from the principle that Ireland was a conquered country, in which neither the natives nor the descendants of the conquerors themselves could have any rights which could restrain the sovereign power, he ruled as a despot, and boasted that in Ireland the king was "as absolute as any prince in the whole world." At the same time he strove to secure order, and to encourage commerce, and during the period of his rule he suppressed piracy, introduced the manufacture of linen, largely increased the revenue, effected some useful reforms in the church, and established a well drilled and regularly paid army. In January, 1640, Charles raised him to the dignity of Earl of Strafford and Baron of Raby, and invested him with the title of lord lieutenant, or lieutenant-general of Ireland, a title which had not been borne since the time of Essex. Later in the same year, the Earl of Northumberland being incapacitated by illness, the king appointed Strafford in his place to the command of the army against the insurgent Scots, before whom the royal troops fled panic-striken after the rout at Newburn, 28th August, 1640. Contrary to his strenuous advice, the king accepted the terms of the Scots, and Strafford, dreading the assembling of Parliament, which the king had been compelled to summon, implored permission to return to Ireland. This the king refused, but instead pledged his royal word "that not a hair of his head should be touched by Parliament." The value of the royal word was soon put to the test, for on 11th November, eight days after the meeting of Parliament, Pym appeared on the part of the Commons at the bar of the House of Lords with a message of impeachment, the articles of which accused Strafford of an attempt to subvert the liberties of the country. Sent to the Tower in spite of the king's safe-conduct, he was placed at the bar, 22nd March, 1641, and during the next fifteen days he defended himself with so much eloquence and ability as to baffle completely his accusers, and compel them to resort to a bill of attainder. This was passed in the Commons by a large majority, assented to by the Lords, who were in a panic of fear, and sent to Charles for approval. That Strafford had plotted to destroy the liberties of the country was most certain, but it was equally certain that he had done this in compliance with the desire of his royal master, whose word had been solemnly pledged for his safety. The king made some feeble efforts to save him, but apprehending popular violence he at last remarked, "If no less than his life can satisfy our people, *fiat justitia*," and signed the death warrant. A man of dauntless courage, Strafford passed on 12th May, 1641, from his prison to the scaffold on Tower Hill, with a calm dignity which commanded the admiration of his fiercest opponents. He was a man of great genius and industry, but his political crimes fully merited the severe punishment which overtook them. At the same time, nothing can excuse the mean cowardice of the king. The attainder was reversed in the reign of Charles II., and the son of Strafford was restored to the earldom. (See Strafford's "Letters and Despatches," edited by Dr. Knowles, 1739; the histories of Hallam, Macaulay, Lingard, Guizot, Ranke, Green, and Gardiner; Forster's "British Statesmen," vol. ii. 1831; "Life of the Earl of Strafford," by Elizabeth Cooper, 1874; and Mozley's "Essays, Historical and Theological," London, 1878).

STRAIGHT LINE. There are three attempts at definition of a straight line: one by Plato (or one of his immediate school), one by Archimedes (as is said), and one by Euclid. The Platonic definition, according to Proklos, is as follows:—"A straight line is that of which the middle parts hide the extremities;" a physical definition owing its truth to the circumstance of the rays of light proceeding in straight lines. Archimedes defines a straight line as the shortest distance between two points. It is one of the postulates in his book on the sphere and cylinder, that of all lines drawn between two points the least is that which is straight. Euclid defines a straight line to be that which lies evenly between its extreme points. The postulates relative to a straight line de-

manded by him are—(1) That such a line can be drawn from any one point to any other; (2) that when terminated, it can be lengthened indefinitely; (3) that two such lines cannot inclose a space.

The definition which Euclid gives of a plane is that of a surface which lies evenly between its bounding straight lines. To this definition there is the serious objection that though a plane may be as easily conceived of as a straight line, yet it is actually capable of definition by a straight line. For a plane is the surface any two points of which can be joined by a straight line which lies wholly on the surface. On the other hand, if we have a plane given us as "a surface which divides space into two congruent regions" (W. K. Clifford), we can define a straight line as a line dividing a plane in an exactly similar way; that is, a straight line is a line of the same shape all along and on both sides. From the conception of a plane it follows further that a straight line is produced by the intersection of two planes. Leibnitz gave yet another definition of a straight line, namely this: If a body be suspended by two points and made to rotate upon them, then all the points which are unmoved during the rotation—that is, all the points along its imaginary axis—make up, in their aggregate, a straight line. When examined and pushed home this definition of a straight line is seen to be a general statement of the intersection of planes.

STRAIN, in music, signifies a part of a "subject;" and as it is rather a vague term it is better replaced by *section*, regarding the section as representing the colon in ordinary punctuation, when the complete musical sentence or period represents the full stop. Or if we compare a musical subject to a stanza of poetry, the strains composing it would be the separate verses (lines). It is usual to mark the strains by double-bars in hymn-books.

STRAIN, DIELEC'TRIC. When electrical induction takes place through a medium (as from the one surface of the Leyden jar to the other), the medium or "dielectric" is strained; and inasmuch as a vacuum is a good dielectric it is evident that this strain is not that of material particles. Hence it is believed that electrical phenomena are due to stresses and their strains (a *stress* is that which produces a *strain*) in the ether which is assumed to pervade all space, and which is the medium by which, as philosophers are driven to imagine, light is conveyed to us. As this ether, if it exist at all, must surround the ultimate particles of all bodies, it must squeeze them when it is itself strained. The glass of the Leyden jar, which we know from tests to be strained under electrical induction, is on this hypothesis strained by the ether, the latter being strained by the electricity. When the strain is too great the layer gives way and is perforated by the spark that at once discharges itself through the dielectric.

STRAITS SETTLEMENTS is the name given to the British possessions in the Straits of Malacca. They consist of SINGAPORE, the town and province of MALACCA, the territory and islands of the Dindings, the island of PENANG, Wellesley Province, and their dependencies, and the Cocos Islands. The last group consists of about twenty islands and islets, lying about 700 miles to the south-west of Batavia and of North Keeling Island, which is about 12 miles to the northward. Intimately connected with the colony are the three protected native states of Perak, Selangor, and Sungai Ujong, situated on the west coast of the Malay Peninsula. These states are under the supervision of the governor of the colony, they each possess a state council, and in each there is a British resident, appointed by the secretary of state for the colonies, and acting directly under the orders of the governor. The aid of the government is often sought by the other more independent states of the peninsula, and this has been especially the case with the small states known as the Negri Sembilau, bordering upon Malacca. These states, formerly at constant war with one another, under colonial policy enjoy peace and order, and have agreed that all differences shall be referred to the governor of the colony for decision. The legislative council has voted considerable sums in their aid, which have been expended on the construction of bridle-paths and roads, and it is believed that with the means of intercommunication now being afforded them, and the good order which has been established among them, these small states will speedily develop.

The government of the colony is as a crown colony, under a governor, with an executive council, subject to the British colonial office. There is also a legislative council, presided over by the governor, and composed of official and non-official members nominated by the crown, as in Ceylon and Hong Kong. The governor usually resides at Singapore, but he is enjoined to sojourn at Penang and Malacca for a certain portion of every year. The aggregate area of the Straits Settlements is about 1500 square miles, and the population in 1881 was 423,384.

The Straits ports are wholly feee from duties on imports and exports. The chief exports comprise tin, sugar, pepper, nutmegs, maize, sago, tapioca, rice, buffalo hides and horns, rattans, gutta-percha, india-rubber, gambier, gum, coffee, dyestuffs, tobacco, &c. The total revenue amounts to £700,000 per annum. In 1876 it was exactly half (£350,000), and in 1868 only £276,000. The growth of the trade will be observed by a comparison of the following table, showing the united exports and imports for the periods mentioned:—

	1859-60.	1876.	1886.
	£	£	£
Singapore,	10,371,300	18,292,180	24,699,226
Penang, .	3,530,000	6,895,923	14,585,383
Malacca, .	920,000	949,371	1,147,301
Total, .	14,821,300	26,137,474	40,431,910

The Straits Settlements were secured to Great Britain in 1824 and made a separate settlement, and placed under the government of India in 1853, but in 1867 they were separated from India and constituted an independent settlement.

STRAL'SUND, a town of Germany, in Prussian Pomerania, situated on the west shore of the narrow strait which separates the island of Rügen from the mainland, 86 miles north-west of Stettin, is a seaport of considerable industrial and commercial activity, and has 30,000 inhabitants, besides a military garrison. Except on the side of the strait the town is surrounded by lakes and marshes, so that it is connected with the continent only by bridges. The old fortifications were razed and the ramparts converted into public walks; but since its annexation to Prussia in 1815 others have been erected on an improved plan. Stralsund is rather gloomy, the houses being built in the old style, the streets irregular, and the squares and market-places small; it is, however, clean and well paved. The three principal churches are in the Gothic style, and contain many fine paintings. Among the other public buildings are—the government-house, the town-house, the gymnasium, with a large library and cabinet of medals, the mint, the arsenal, lunatic and orphan asylums, and the waterworks. The manufactures include woollens, linen, sugar, starch, soap, candles, tobacco, leather, looking-glasses, household furniture, playing-cards, spirits, and oil. The chief exports are corn, malt, beer, timber, linens, and wool. Ships are built, and a great number of merchant and fishing vessels belong to the port. The harbour is spacious and safe, and in places deep enough for ships drawing 15 feet water, although close to the town it is only about 7 feet deep. Stralsund was founded in 1209

by Prince Jaromar I. of Rügen, and peopled with Saxons. It afterwards became a free imperial and Hanse town, and rose to great commercial importance. It has repeatedly suffered severely from war; was unsuccessfully besieged by Wallenstein in 1628; but in 1678 Frederick William, the great elector of Brandenburg, took it after a bombardment, by which 1800 houses were destroyed. In 1713 and in 1807 it was also captured, and finally annexed to Prussia in 1815.

STRAMO'NIUM. See DATURA.

STRANG'URY (Gr. *strangouria*), a difficulty in voiding urine, which is nevertheless accompanied by a frequent and uncontrollable desire. The passage of the water is attended by burning and cutting pains along the course of the urethra, which sometimes extend even to the kidneys, implicate in their effects the whole of the rectum, and produce the straining condition known as *tenesmus*. The usual cause is the presence of irritant substances in the urine, especially cantharides or Spanish fly, when the drug has been employed as an external or internal remedy, and oil of turpentine. It likewise occurs in acute or chronic inflammation of the bladder, prostate, and urethra, in stone of the bladder, and in advanced stricture of the urethra. The treatment must be adapted to the special cause of this symptom, while the more urgent local pains may be relieved by the use of warm hip baths, hot fomentations, and the use of anodynes.

STRANRAER, a town of Scotland, the principal seaport of Wigtownshire, and a royal burgh, stands at the head of the bay called Loch Ryan, about 25 miles west by north from Wigtown, and 406 from London. The town is irregularly built on broken ground, and though there are many buildings of architectural pretension, their effect is spoilt by the latter circumstance; the chief are the town hall (1872–73), the castle, dating from the fifteenth century, the parish, Established, two Free, two U.P., Reformed Presbyterian, United Original Secession, and Roman Catholic churches, and the Academy. Owing to increased railway facilities there is a considerable transit trade for the short sea-passage to Belfast. There are no manufactures, but around the town is a rich agricultural district, much of the produce of which is exported from it, and a valuable oyster fishery exists in Loch Ryan, near the port. There is a pier, to which tolerably large vessels can come up at full tide, but the beach is dry at low water. The trade is with Glasgow, Liverpool, and other large towns. The population in 1881 was 6415.

STRAPPA'DO would hardly need notice were it not for the frequent quotation of Falstaff's speech ("1 Henry IV." ii. 4), "An I were at the strappado or all the racks in the world I would not tell you on compulsion. If reasons were as plentiful as blackberries I would give no man a reason on compulsion, I!"

The strappado (Ital. *strappare*, to pull) was a modified form of the Italian word *strappata*, and signified a military punishment, which consisted in hauling up an offender by a pulley fixed to a beam and then letting him suddenly fall again with the probability of dislocating his shoulder. It has nothing to do with "strap," as might appear on first sight.

It might be well to add, as the quotation is so well known that the point of the jest is often missed by those who do not remember, that the vowel sound *ea* in earlier times was what we now write as *ai* or *ay*. (The Irish still talk of the "blue say" or a "cup of tay" quite correctly; London pronunciation has deviated to "see" and "tee.") Falstaff, therefore, says that if *raisins* (foreign fruit) were as plentiful as the native wild blackberries he would not give one of them upon compulsion. The French word *raison* was, in fact, in use, though its spelling was disguised.

STRAS'BURG (Ger. *Strassburg*, "a town on the way," so called from its being on the Roman street or road), a large, ancient, and very strongly-fortified city, formerly the capital of the French department of Bas-Rhin, but now belonging to Germany, is situated on the Ill and the Bruche, within 2 miles of the left bank of the Rhine, and in 1881 had 104,471 inhabitants.

Strasburg stands on the site of the Roman *Argentoratum*, which fell in 455 into the hands of the Allemans, who completed its ruin. In 496 a fort called *Stratæburgum* was built on the site of the ruined city. The spot remained little better than a heap of ruins till the year 718, when Adelbert, duke of Alsace, founded the abbey of St. Etienne. From 870 it was annexed to the German Empire, being nominally governed by counts and bishops, but still maintained the right of making its own laws and naming its own magistrates, subject only to the approbation of the bishop and his chapter. These privileges with the power to impose taxes and make treaties, besides several other immunities, were granted to or conferred on the city by an edict of the Emperor Philip in 1205. Soon after, in 1253, Strasburg and the other cities on the Rhine from Basel to the Moselle formed a league for their mutual defence, and maintained a force of 100 boats, manned by archers, to keep the navigation of the Rhine free. From this time, for nearly three centuries, the history of the city presents a continued and mostly successful struggle of the citizens in defence of their liberties against their bishops or the robber nobles. By the treaty of Westphalia the house of Hapsburg ceded the sovereignty of Alsace to France. After its union with France its population and prosperity very much increased, but it always remained to outward appearance a German town. It had long been a principal ferry between France and Germany, by means of a bridge of boats across the Rhine; but in 1861 an iron railway bridge was also completed, the two centre arches of which were removable in case of war. In 1870 one of the first acts of the Germans was to blow up the whole of the solid part of the bridge on their side of the river, in order to render more difficult an invasion in that direction. Strasburg was completely invested by the Germans on 10th August, and was only surrendered after a very heroic resistance on 28th September; and two days after, on the anniversary of its surrender to the French in 1681 by a surprise, the Germans entered the city. More than 500 houses had been destroyed during the siege, and 8000 persons rendered homeless. The city was finally ceded to Germany in 1871, and now forms the capital of the German province of Alsace.

Strasburg stands in a flat situation in the valley of the Rhine, is irregular in form, and its circuit is 5 or 6 miles. Since 1871 the former French works have been inclosed on the western side of the town by twelve massive forts, making a vast curve 6000 yards from the old enceinte. They stand 3000 yards distant from each other, with a minor battery between each pair. Three other large forts cover the railway bridge and passage into Baden at Kehl, and the whole fifteen have been furnished with the most powerful armament and the most complete equipment and protection which modern military science could produce.

The river Ill flows through Strasburg in a N.N.E. direction. After it enters the town it is divided into several branches, which reunite before it quits the city. It is, generally speaking, well built; the principal streets are wide and well laid out; the squares large and regular. The houses are high, and surmounted by lofty roofs, furnished with two or three tiers of windows.

The principal public building is the Cathedral of Notre-Dame, originally founded in 504. The modern edifice was not, however, commenced till 1015, and not completed till 1439. It is a building of singular beauty, and ranks, with the cathedrals of Cologne and Freiburg, as one of the most sublime specimens of Gothic architecture in the world. The interior is 357 feet long, 79 high from the pavement

to the vault, and 35 wide, not reckoning the aisles, which are separated from the nave by nine massive pillars on each side. The interior is lighted through splendid stained glass windows, of which that over the great western portal is a magnificent circular one, 48 feet in diameter. The stone pulpit, unequalled for the richness, variety, and beauty of its sculptured ornaments; an organ of admirable power and softness; and the famous astronomical clock, representing the planetary system, and indicating the days of the month and the places of the sun and moon, in the south transept, are the most remarkable objects of the interior. The clock was made in 1571, and after going for about 200 years it got out of order, and was useless for above fifty years; it was then put into complete repair by a watchmaker of the town, and still maintains its character as a most elaborately-finished, complicated, and surprising piece of machinery. It escaped completely uninjured in the siege of 1870. The western front of the cathedral, exceeding 230 feet high, with its triple portal decorated with sculptures, statues, and bas-reliefs, is a masterpiece of enriched architecture. The northern tower is surmounted by a spire, terminating in a cross, which is 466 feet above the pavement, higher than that of St. Peter's at Rome. This spire was commenced in 1277, but was not finished till 1439, and is one of the highest in the world. Such is the admirable finish and delicacy of the workmanship, and so great the hardness of the material with which the west front is constructed, that it has been compared to a veil of the finest cast iron thrown over the more solid parts of the gigantic mass of building. The cathedral was much injured during the French Revolution, but was subsequently restored. During the siege of the city in 1870 the Germans spared the building as much as possible, and it was only slightly injured, the whole damage done to it, chiefly from splinters of shell, being estimated at about £2000. There are some other fine churches in Strasburg.

The principal public buildings are the episcopal palace, the town-hall, the court-house, the university academy buildings, which contain extensive collections of natural history and anatomy, and a medical library; the college, erected by the Jesuits; the large episcopal seminary; the civil hospital; the orphan asylum; and the corn-market. The public library of Strasburg, consisting of above 200,000 volumes, was kept in the building of which the Temple-Neuf formed part, and was destroyed during the siege of 1870. The loss was, of course, to a great extent irreparable, but the Germans at once founded a new library, which contains upwards of 500,000 volumes. Among the military structures must be named the arsenal, the artillery school and cannon-foundry, the Finkmatte and several other barracks, and the hospital.

The public walks are numerous, those called La Robertsa and Le Contades being the most frequented. The banks of the Rhine, the Ill, and the Bruche also afford pretty walks and views. On an island in the Rhine, seen on the road to Kehl, stands a monument in honour of Desaix. A statue of Gutenberg, who made his earliest attempt at printing in Strasburg, has been erected in the vegetable market, now called Place Gutenberg. On the Polygon, a piece of ground about a mile from the town, a monument is erected to General Kleber, a native of the city. Marshal Kellerman and Schœffer, who contests with Gutenberg the invention of printing, were also born here.

Strasburg has an exchange and chamber of commerce; a university academy which confers degrees, and in connection with which there are in the town faculties of law, Lutheran theology, medicine, science, and letters, and a national college; also an ecclesiastical college, schools of midwifery and pharmacy, a society of agriculture, science, and art, besides various other educational, literary, and scientific institutions. The botanical garden was used as a cemetery during the siege of 1870.

The trade of the town is very considerable; its manufactures include beer and leather (for which it is specially famous), jewelry, metal buttons, starch, alum, soap, watches and clocks, chemical products, steel, cutlery, pins, combs, cast-iron goods, earthenware, porcelain, enamel, oil for seeds, hats, woollen and cotton stuffs, cotton yarn, hosiery, printed flannels, sailcloth, oilcloth, thread, carpeting, furs, paper-hangings, playing cards, &c. There are bleach-grounds, dye-houses, rope-walks, tanyards, distilleries, chicory, mustard, and madder mills; printing offices, plaster kilns, tile yards, copper and iron forges, type foundries, sugar refineries, a snuff manufactory, &c. Strasburg has, besides, a large bookselling trade, and is also famous for its hams, sausages, and fat liver pies. There is also a considerable transit trade carried on by steamers on the Rhine and the various lines of railway, with Holland, Germany, Switzerland, Italy, and indeed all the west of continental Europe, and much business is done in the produce of the surrounding territory, which includes corn, wine, tobacco, turpentine, madder, hemp, hops, saffron, &c. Steamers ply to Basel and Rotterdam, and the trade of the town is much facilitated by the railways and canals, the latter connecting it with all the great rivers of France and with the Danube.

STRAS'BURG OATHS, THE, sworn in 842 by Charles the Bald and Louis (Ludwig or Chlodwig) the German against their brother Lothar, are among the most remarkable monuments in literature; for they are the undoubted actual beginning of the French language, without a rival, except perhaps the Reichenau gloss. Their value is simply incalculable for all students of the development of what are called the Romance tongues; for we catch here, as it were, Latin in the very act of transformation into French. Besides, the fact of the language of the oath being Old-French shows that the Frank army had lost their power of speaking German, the original tongue of their fathers, or otherwise the Emperor Ludwig would not have sworn to them in French.

The great importance of these oaths justifies their insertion, side by side with a modern French translation:—

Oath by Ludwig the German.

Pro Deo amur et pro christian poblo et nostro commun salvament d'ist di en avant, in quant Deus savir et podir me dunat si salvarai meon fradre Karlo et in adjudha et in cadhuna cosa, si cum om per dreit son fradra salvar dist, in o quid il mi altresi fazet; et ab Ludher nul plaid numquam prindrai, qui meon vol eist meon fradre Karlo in damno sit.	Pour l'amour de Dieu et pour (le salut du) peuple chrétien et notre commun salut de ce jour en avant autant que Dieu me donne savoir et pouvoir je sauverai mon frère Charles et en aide et en chaque chose, ainsi qu'on doit, par droit, sauver son frère, à condition qu'il en fasse autant pour moi; et avec Lothar je ne prendrai aucun accord qui, par ma volonté, porte préjudice à mon frère Charles, ici.

Oath by the Soldiers of Charles the Bald.

Si Lodhuwig's sacrament que son fradre Karlo jurat, conservat, et Karlus meos sendra de sua part non los tanit, si is returnar non l'int pois, ne io, ne neuls cui eo returnar int pois, in nulla adjudha contra Lodhuwig nun li iv er.	Si Louis garde le serment qu'il a juré à son frère Charles, et Charles mon maître, de sa part, ne le tient pas, si je ne l'en puis détourner ni moi, ni nul que j'en puis détourner, ne lui serai en aide contre Louis.

STRAT'EGY (from the Greek *strategia*, which may be translated generalship) is properly the science of combining and employing the means which the different branches of the art of war afford for the purpose of forming projects of operations, and of directing great

military movements. It is distinguished from the art of making dispositions and of manœuvring when in the presence of an enemy, which is included in the term TACTICS. Strictly speaking, however, strategy is of the two the most important science, inasmuch as it is by strategy that those great advantages of position are obtained previous to the action which very often decide the fate of the day. It is the business of the strategist to exercise that forethought in the establishment of bases and depots, and the concentration of troops, whereby the greatest advantages are secured for the subsequent display of tactics. Many remarkable instances of successful strategy are recorded during the American War in 1864, though one general, Sherman, achieved peculiar renown by the brilliancy of his tactics apart from strategy. So also did Wellington in 1813, when advancing from Portugal through Spain into France, while his Salamanca campaign affords a striking instance of the advantages of strategy. In the Franco-German War of 1870–71 Count von Moltke displayed marvellous ability both as a strategist and tactician, while the Russo-Turkish War of 1877–78 showed in several instances how defective strategy might result in enormous losses without the gain of any adequate advantage. Stratagem, though related to strategy, is distinct, being rather a part of tactics, and refers to special devices for deceiving the enemy, such as ambuscades, feint bugle calls to imaginary troops, concealment of infantry by clouds of cavalry, &c.

STRAT'FORD, a town of England, in the county of Essex, 4 miles E.N.E. of London, on the Roman way to Colchester and on the river Lea, three-quarters of a mile beyond Bow. It is a rapidly increasing suburb of London, containing the locomotive and other workshops of the Great Eastern Railway, chemical and dye works, distilleries, &c. A town-hall and assembly rooms, the Gurney memorial, and several churches are its chief buildings. The population of the ecclesiastical district in 1881 was 36,455. Stratford is included in the borough of West Ham.

STRATFORD, STONY. See STONY STRATFORD.

STRATFORD-DE-REDCLIFFE, STRATFORD CANNING, VISCOUNT, an eminent English diplomatist and statesman, was born in 1788. He is chiefly remembered in connection with his services at the court of Constantinople. He was a cousin of the celebrated George Canning, by whom he was first introduced into the Foreign Office. After various services in the United States, and in several of the courts of Europe, including Constantinople, he was appointed in 1841 ambassador to Constantinople, and held that position, in which he acquired almost unprecedented influence, till 1858. A very vivid picture of the diplomatic struggle between him and the Russian ambassador at Constantinople, prior to the Crimean War, is given in Kinglake's "Invasion of the Crimea," where he is described as the "Great Eltchi." During a portion of his career he sat in the House of Commons as member for Old Sarum, Stockbridge and King's Lynn; and was raised to the peerage in 1852, his title being chosen by himself, on account of his descent from William Canynge, the founder of the Church of St. Mary Redcliffe, in Bristol. In 1845 he rendered important pecuniary assistance to Mr. Layard in his researches on the site of Ancient Nineveh. In early life he published a poem entitled "Bonaparte," which attracted considerable notice. He was also the author of "Why am I a Christian?" (1873), "The Greatest of Miracles" (1876), and a dramatic poem entitled "Alfred the Great in Athelney" (1876). He died on 14th August, 1880.

STRAT'FORD-UPON-AVON, a market-town and municipal borough of England, in the county of Warwick, 8 miles south-west of the town of that name, and 110 miles from London, is situated on the west bank of the Avon, which is here crossed by a large stone bridge. The town slopes gently towards the river, which is a copious but sluggish stream. The town-hall, a Tuscan building, was erected in 1768. The house in Henley Street in which Shakespeare was born (26th April, 1564), has been purchased for the nation by subscription, and is in the charge of certain trustees, and there is a Shakespeare museum and library in connection with it. It has been visited by pilgrims from every civilized country. The parish church, in which he was buried, and which contains his monumental bust, executed by Gerard Johnson about 1628–30 [see illustration, article SHAKESPEARE], and the graves of his wife and daughters, is large and handsome, with a central Early English tower. New Place, the house in which Shakespeare resided in his latter years, was pulled down in 1759. The town contains a memorial theatre, built in 1879. A handsome jubilee drinking fountain and clock-tower was erected at the cost of an American citizen, in 1887. The grammar-school, where Shakespeare was educated, dates from the reign of Henry VI. There are also a market-house, almshouses, dissenting chapels, and an ancient building known as the Guild Hall. The rich pastoral scenery of the Avon valley is full of tranquil beauty, and has been commemorated by poet and artist. That it inspired the imagination of Shakespeare himself is evident from many passages in his dramas, and the characteristics of the river are vividly sketched in Act II. scene 7, of the "Two Gentlemen of Verona." For accurate descriptions of this classic neighbourhood the reader is referred to Charles Knight's "Shakespeare: a Biography;" Hawthorne's "Old Home," Washington Irving's "Sketch Book," and James Thorne's "Rambles by River." The municipal borough of Stratford, incorporated by charter in 1553, is governed by six aldermen, one of whom is mayor, and eighteen councillors. The population of the borough in 1881 was 8053.

STRATHFIELDSAYE, a parish of England, in the counties of Hants and Berks, 6½ miles N.N.E. of Basingstoke. It contains the principal portion of the estate conferred by Parliament on the Duke of WELLINGTON and his family, for his services in the Peninsular War. The mansion is a plain but elegant edifice, and the park is about 1½ mile in length by 1 mile in breadth. The property is situated on the Lodder, and it formerly belonged to the great Earl of Chatham and his son, William Pitt. On the domain is the site of the ruined city of SILCHESTER.

STRATHMORE' (the Great Valley), an extensive lowland tract in Scotland, in a wide acceptation extending from the county of Dumbarton north-east to the sea at Kincardineshire, embracing part of Stirlingshire and of the counties of Perth and Forfar, bounded N. by the Grampians and S. by the Lennox, Ochil, and Sidlaw hills. In a more limited sense it comprises the tract from Methven, county of Perth, to Brechin, county of Forfar, 40 miles in length, watered by the Tay and its affluents. It is the greatest plain in Scotland, and gives the title of earl to the Lyon family.

STRATHSPEY', a Scottish dance closely akin to the reel, slower in time, but more exhausting on account of the greater exertion it requires. Whereas the reel is often played with equal quavers, the strathspey demands continual dotted notes, in the style familiarly known as the "Scotch snap." The name comes from the strath (valley) of the Spey, whence the dance is famed to have originated.

STRATIFICA'TION, a peculiarity of rocks that have originally been deposited as sediment beneath water. It depends (1) upon the alternation of layers of different material, (2) upon changes in the size or shape of the particles in successive layers, (3) upon the intercalation of flaky minerals like mica, (4) upon intermittent deposition, or (5) upon the effects of pressure. Or any two or more of these causes may combine to produce the result. When the stratification is very marked and the sediment fine, the

rock is *laminated* or shaly—a peculiarity that must not be confounded with the effects of "cleavage," as shown in SLATE. And when the rock is not quite so fissile, but readily splits into slabs of moderate thickness, it becomes a *flagstone*. Less distinctly stratified rocks can only be easily removed in thick layers; and sandstones of this character are of great value for masonry, being known as *freestone*, from the facility with which they can be worked in any direction.

STRATIFIED or **FRAGMENTAL ROCKS.** See GEOLOGY.

STRATIO'TES, a genus of plants belonging to the order HYDROCHARIDEÆ. *Stratiotes aloides* (water-soldier) is a very ornamental aquatic plant, and is found in ditches in the east of England. It has been naturalized in Scotland and Ireland. It resembles a small American aloe, but usually grows submerged, rising to the surface to flower, and then sinking again. The leaves are numerous, springing from the root, sword-shaped, and pellucid. The beautiful delicate white flowers are borne in a two-leaved spathe; they have six segments, the three outer being green. The flowers are of two kinds, male and female, borne on separate plants; the male flowers are numerous, with twelve or more stamens surrounded by many imperfect ones; the female flowers are solitary, with six deeply bifid styles and numerous sterile stamens, which sometimes become perfect. The fruit is a six-celled, many-seeded berry. The water-soldier spreads with great rapidity, and hence it is inadvisable to introduce it into artificial waters.

STRATONI'KE, a favourite name among the princesses of the Greek (Alexandrine) dynasty of Syria, as Kleopatra was with those of Macedon and Egypt. The first Stratonikê of note was the wife of Antigonos, king of Asia, one of the generals of Alexander; and she was the mother of Dêmêtrios Poliorketês. But by far the most famous, because of her romantic story, is her granddaughter, the daughter of Dêmêtrios, who was married when only seventeen to Seleukos, king of Syria (B.C. 312–280). Antiochos, her husband's son by a former wife, fell in love with her, and was on the point of death, honourably striving against his passion; the true case was, however, discovered by the old king, and he gave up Stratonikê to his son. The queen seems to have been perfectly blameless in the matter. Antiochos came to the throne of Syria (280–261), and his son by Stratonikê succeeded him as Antiochos II. (261–246); their daughter Stratonikê married Dêmêtrios, king of Macedon, whom she quitted when he married another wife, and retired to Syria. Here she raised a revolt against the reigning monarch, her brother's son, Seleukos II. (246–226), and he caused her to be put to death.

STRA'TUS, one of the varieties of clouds. See CLOUD.

STRAUB'ING, a town in the province of Lower Bavaria, 25 miles east from Ratisbon, on an eminence above the right bank of the Danube, here crossed by a bridge, has 12,000 inhabitants. It is tolerably well built. There are several churches and hospitals, a gymnasium, a training school for schoolmasters, and many charitable institutions. The handsomest part is the great square, in which are the Church of the Holy Trinity, the palace, the town-house, the government-house, and the Church of St. James and St. Veit. In a little chapel in the town a monument has been erected to Agnes Bernauer. Straubing stands in a remarkably fertile country; it has no manufactures of importance, the population being chiefly engaged in agricultural pursuits. Large corn and cattle markets are held here; beer is extensively brewed, and there is a considerable trade in agricultural and other products on the Danube.

STRAUSS, DAVID FRIEDRICH, a distinguished German writer of philosophical theology, in the most advanced form of rationalism, was born on 27th January, 1808, at Ludwigsburg, in Würtemberg. He was educated for the ministry, entered in 1830 on his duties as a pastor, and in 1832 was appointed to a post in the theological seminary at Tübingen. In 1835 he suddenly startled his friends and the public by the publication of his "Life of Jesus," in which he maintained that the gospel narratives were the embodiments of profound speculations and impulses, and that they were myths, not in the sense of being fictitious narratives, but as being the form into which philosophical and poetical tendencies and the Old Testament prophecies of the Messiah were crystallized in the first two centuries. Subsequent writers of the advanced school, including Renan, have all acknowledged that they borrowed largely from him; and indeed, with German industry, Strauss has collected practically every conceivable objection to the scriptural narratives.

The natural result of his speculations was at length developed by himself in the remarkable book he published in 1873, under the title of "The Old and the New Faith." In this work he pushed his arguments to their natural conclusion, and finally abandoned all pretence of being a professor of orthodox Christianity. He declared, for himself and those who thought with him, that they had ceased to be, in the dogmatic sense, Christians; and he developed a philosophical conception of the universe in which man was but an atom in a self-developing *universum*. All personal relationship to a Deity, and all practical regard to a future life were entirely abandoned; and, in short, he reduced his philosophy and religion to slender tenets. It was quite characteristic of the man that he should publish his "Life of Jesus" while holding the office of pastor of a church; and he thought it equally consistent, while holding his peculiar views, to become professor of dogmatic theology and church history in the Zurich University. The singular appointment, however, raised a storm which compelled him to retire. Strauss was not, as is frequently supposed, a mere unbeliever. What he claimed as his function was to reconstruct Christianity on a philosophical basis, and to develop what seemed to him the secret meaning of the New Testament. The career of Christ, in his view, symbolized the moral history of mankind. Humanity was God manifest in the flesh, sinless, dying, rising, and ascending to heaven; and the dogmas of Christianity were verified, not in the individual, but in the race. Even to those who disagree with Strauss there is something splendidly audacious in a young man of twenty-seven undertaking to reconstruct the whole of the Christian faith, to demolish all the venerable orthodox traditions of its Founder's life, and to establish a totally new interpretation of them. Strauss was a voluminous writer, and published numerous other works besides the two mentioned, the principal of them being "Christian Doctrine in its Historical Development and in its Struggle with Modern Science," and "Julian the Apostate." For a short time he held a seat in the Diet of Würtemberg, but his constituents became so dissatisfied with his singular tendencies that he resigned his seat. He died on 8th February, 1874. See "David Friedrich Strauss in seinen Leben und seinen Schriften geschildert," by Eduard Zeller (Leipzig, 1874; English translation, London, 1874), and Hausrath's "Biography of Strauss" (Leipzig, 1878).

STRAUSS, JOHANN, a composer of dance music, was born at Vienna on 14th March, 1804, where he died in 1849. He was apprenticed to a bookbinder, but his love of music tempted him to practise the violin so diligently that, in 1823, he was able to take an engagement in Lanner's orchestra, then in great vogue for the performance of dance music, and he accordingly abandoned his trade. In course of time he organized an orchestra of his own, and his remarkable ability as a conductor brought the playing of his little band to a rare degree of perfection, and the great attraction of this was heightened by the peculiar charm of his music. He wrote with great rapidity. In

1838 Strauss came with his band to London, where their playing created a sensation far beyond what the importance of their concerts merited. His waltzes and galops have been universally popular. They are characterized by most fluent and piquant melody, and by brilliant, original, and eminently effective orchestration. Strauss was a good violinist, and played solos occasionally at his own concerts. His son succeeded him at the head of his orchestra, but afterwards left the band, and applied himself particularly to the study of the violin, and he is now classed among the foremost players upon this instrument. Eduard Strauss, the grandson, brought the still famous orchestra to London during the International Exhibition of 1885, when numerous performances were given in the Albert Hall, and the greatest interest was excited.

STRAW FIDDLE. See STROHFIEDEL.

STRAW, JACK, was one of the principal leaders in the peasant revolt of 1381, the best known captain in which was Wat Tyler. Jack Straw led the men of Essex into Kent, the first open insurrection in the movement. Canterbury threw open its gates, the archbishop's palace was plundered, the popular priest, John Ball, was dragged from his prison and delivered his impassioned socialistic harangues to somewhat like 100,000 men. Wat Tyler now took the command, and the force moved on London with what result is but too well known. [See PEASANT WAR.] Deluded by false promises, and their leader foully murdered, the peasants separated. When the royalists took a dastardly revenge upon the separate small parties returning singly to their homes, much guerilla warfare went on. One such combat is memorized in "Jack Straw's Castle," now a tavern, at Hampstead. It is not unlikely that Wat Tyler, Jack Straw, &c., were names assumed by the peasants. In the end Jack Straw was taken by the notorious Sir William Walworth, Tyler's assassin; and under promise to pay for masses for the peasant-chief's soul, Walworth induced him to confess. It is a curious confession, akin to the wild dreams of the Fraticelli of Italy. He prophesies and longs for the time when the beggars shall possess the earth; or, as his friend Ball put it,

> "When Adam delved and Eve span,
> Who was then the gentleman?"

STRAW MANUFACTURES. It is not known with any certainty when the manufacture of hats and bonnets of plaited straw became important in Italy, but it is evident that for many hundred years it has formed one of the leading pursuits of the agricultural population; and from Coryat's "Crudities," published in 1611, it appears that "delicate strawen hats" were worn at that time by the inhabitants of Piedmont, both male and female. We owe the introduction of the art into the British Isles to Mary Queen of Scots, who had observed the use of straw bonnets among the Lorraine peasantry; and by James I. it was afterwards imported into England, where it took root and flourished in Bedfordshire.

The large size of the wheat straw used in this country for plaiting prevented the home manufacture from entering into competition with that of Italy in articles of the finest quality, since the straw grown for the purpose in Tuscany was much smaller and superior in colour. This difficulty has been somewhat overcome by the expedient adopted in England towards the end of the last century of splitting the straw, and using the narrow splints or slips. This operation is now performed by small cutting instruments called machines, which possess a number of little square blades, so fixed as to divide the straw by a motion in the direction of its length into as many slips as there are blades. Before machines were invented straws were occasionally split with knives by hand. But greatly as the British straw-plait manufacture had been encouraged by the use of split straw, by improvements in bleaching, and by increased care in the selection of straws of uniform size and colour, it was found, when the re-establishment of peace in 1815 allowed the free importation of Italian straw bonnets, that the home manufacture was unable to compete with the foreign, notwithstanding the heavy protecting duty then levied upon hats and bonnets of straw imported from other countries. The Society of Arts for a long series of years encouraged attempts for the improvement of the British straw manufacture, which called forth interesting communications, and proved eventually successful.

In plait made of split straw, unless two splints are laid together with their inside surfaces towards each other, as in the patent Dunstable, it necessarily happens that the face of the plait exhibits alternately the outer and inner surfaces of the straw, which differ from each other in colour and gloss. Articles made of split straw are also inferior to those of whole straw of equal fineness in pliability and durability. Another circumstance which greatly increases the beauty of Leghorn plait is the mode of joining it, so as to form, by the combination of several narrow strips, an extended sheet of plaited work. British plait is usually joined by making the several rows of plait overwrap each other a little, and then stitching through the two overwrapping pieces with a needle and thread. The surface of a hat or bonnet joined in this manner consists of a series of ridges, and part of each row of plait is concealed by that next above it, so that an unnecessarily large quantity is required to form a given extent of surface. Leghorn plait is formed in such a manner that it may be joined without this loss, the edge of one row being, as it were, knitted into the edge of the other in such a way that the pattern may appear uninterrupted, and the line of junction may be almost invisible.

Bleaching the straw with sulphur fumes is commonly practised in this country, and a solution of chloride of lime may be advantageously applied. Straw may be dyed, for ornamental purposes, of many different colours.

The British straw-manufacturing district comprises Bedfordshire, Hertfordshire, and Buckinghamshire, these counties being the most favourable for the production of the White Chittim and Red Lammas wheats, commonly used for English plaits. The manufacture is also followed in a few places in Essex and Suffolk, but very little in other counties. The principal markets are Luton, Dunstable, and St. Alban's. Everywhere, however, the harvesting is productive of anxiety, since the material is peculiarly liable to injury from wet and other causes.

The harvests are generally sold to straw factors, who employ labourers to draw the straw and to remove the ears, which are all cut off by hand for thrashing. The straws are afterwards cut into lengths and cleared of the outer sheath, and they are sorted to various thicknesses by an apparatus consisting of a series of sieves. This part of the manufacture is generally performed by boys, whose duty it is to hold a handful on end over the first sieve, and to permit none but the thinnest straws to enter. They proceed in the same way with the latter, placing them on the second sieve, and so on to the last. And thus falling through successive sieves, the straws pass down the hollow shafts by means of tin or sheet-zinc shoots into boxes placed underneath. They are then removed, made up in bundles, and consigned to the splitters, by whom they are reduced to splits of the required size.

In Italy the manufacture is chiefly followed in the neighbourhood of Florence, Pisa, Siena, and Val d'Arno, in Tuscany, and it is also established in Venice and other places. There, as in England, the occupation is purely domestic. The chief market is Florence, and the demand is principally from England, France, Germany, and America.

There are many kinds of straw plait made in England, known by the names of whole Dunstable, patent Dunstable, split straw, Devonshire, Luton, Bedford, Leghorn, Italian backbone, lustre, wave, diamond, &c., differing

from one another in the straws being whole or split, in their thickness, their number, or in other particulars. There has also, within the last few years, been a great extension given to the trade by the combination of lace, whalebone, mohair, and other substances with the straw, leading to the production of very beautiful fabrics.

The numerous large manufactories which have sprung up in Luton are devoted, not to the manufacture of plait, but to the making of the plait into hats and bonnets. Most of the manufactories have branch establishments at Dunstable, St. Alban's, and other places. The plait-sewing is done entirely by females, the blocking being performed by men, of whom there are about twenty, also two or three boys, to every 250 female workers. The growth of the bonnet-making trade in Luton has increased to such an extent that it has driven the plaiting further off; and the staple occupation in the town and for 7 miles round is that of plait-sewing. The manufacturers attend to all fluctuations of fashion, and the workpeople have to adapt themselves to frequent changes in material, form, and manipulation. Besides its value for plaiting, straw is much used in the manufacture of paper.

Efforts have frequently been made to introduce the Canton or Chinese plait, and they have since 1873 been so largely successful that the price of the English plait has been considerably reduced, and there has been a serious falling off in the Dunstable trade. The hat or bonnet made of Dunstable plait would still be chosen by a connoisseur, but those who study comfort and economy only are well pleased to secure the Canton at a much lower price. The general appearance of the Chinese article is not inferior to the Dunstable, and owing to the lower price of labour it can be produced far cheaper.

STRAW'BERRY (Fragaria) is a genus of plants belonging to the order ROSACEÆ, furnishing the well-known wild and cultivated fruit of the same name. The species are perennial herbaceous plants, which throw out runners, long weak branches, which take root again at some distance from the parent plant, and give rise to independent plants. The leaves are compound, with three deeply-toothed leaflets. The flowers are borne on an erect flower-stalk, and have a ten-cleft, spreading, persistent calyx, five petals numerous stamens, and the pistils seated on a fleshy receptacle. What is popularly regarded as the fruit is actually the receptacle, which becomes greatly enlarged and succulent, the true fruits being the small seed-like achenes which are scattered over or sunk in its surface. There are several species, found in the temperate parts of the northern hemisphere, and in the mountains of South America; and numerous varieties have been established by cultivation.

The Wood or Alpine Strawberry (*Fragaria vesca*) is common in woods and thickets in Britain. It is also found throughout Europe, in Northern and Central Asia, and in North America. The fruit is small, but well-flavoured. This was the earliest species cultivated in this country "Strabery rype" is mentioned among the cries of London in the ballad "London Lickpenny," written about 1420 by Lydgate, the monk of Bury. Another interesting reference to the strawberry in connection with London is found in "Richard III.," where Shakespeare makes the king refer to the excellence of the strawberries growing in the garden of the Bishop of Ely in Holborn. The Green Strawberry (*Fragaria viridis*), perhaps not a distinct species, is another European plant, with a small greenish fruit. The Hautbois (*Fragaria elatior*) is a native of North America, and is occasionally found in groves in the south of England. It has plicated rugose leaves. The shape, size, and colour of the fruit of the hautbois are subject to great variation, according to its mode of cultivation. It is the parent of a great number of varieties known in gardens, most of which, when properly managed, produce fruits of a first-rate kind. The Virginian or Scarlet Strawberry (*Fragaria virginiana*) is a native of Virginia, and to this species belongs the great list of sorts cultivated in gardens, and known by the name of Scarlet and Black Strawberries. The various kinds of Scarlet, Globe, Cone, and some Pine Strawberries are produced from this species. It was introduced into this country in 1629. The Large-flowered Strawberry (*Fragaria grandiflora*) is a native of Surinam, and has furnished our gardens with the sorts called Pine Strawberries. The various sorts named Bath, Pine, Carolina, Dutch, and others, belong to this species. The Chili Strawberry (*Fragaria chilensis*) is a native of South America, and the Pacific coast of North America as far north as Oregon; it is probably not distinct from the preceding species. The whole plant is covered with silky hairs, and the flowers and fruits are large. It is of vigorous growth, and in the south of France, where it was introduced in 1712, it thrives well. It is rather tender for our climate, but some valuable varieties have been obtained by crossing it with other species. The Indian Strawberry (*Fragaria indica*), a native of upper India, has showy yellow flowers, but the fruit is insipid.

Strawberries, when ripe, may be eaten in almost any quantity without injury. They are frequently eaten mixed with sugar and cream or wine. When well grown they hardly require such additions; but when their sugar is deficient, this ingredient may be safely added; and wine under these circumstances should be preferred to cream, as the latter is very liable to disagree with delicate stomachs.

Strawberries may be propagated either by means of their suckers or runners (whose straw-like appearance gives the name to the plant), or by sowing seed. The young plants will generally bear the year after they have been planted or sown. In order to obtain the fruit in perfection, they should be planted where they have access to abundance of light and air. A rather tenacious soil, sloping towards the sun, is most suitable. Moisture and abundance of manure are necessary. Plants grown from runners are best for new beds, and should be planted out in March, in beds with three or four rows, leaving an alley between each bed. The alleys should be 3 feet wide, the rows 18 inches apart in the beds, which should be kept clear from weeds, and the runners cut at least three times in the season. In the autumn the rows should be dug between, and in the spring some straw or dung should be laid between them. Strawberry beds should be renewed after four years in all cases, and some varieties will not produce good crops for so long.

STREAK OF MINERALS, an important feature to be noted in the determination of many mineral species. It is the coloration or appearance of the fine powder left on rubbing the specimen across some slightly rough material harder than itself. Sometimes the streak is shining, sometimes white, often of the same colour as the mineral-mass itself, and often lighter or darker.

STREAM TIN. See TIN ORES.

STREET, GEORGE EDMUND, R.A., F.S.A., the architect of the noble pile of the great Law Courts, London, was born at Woodford, near London, in 1824. He studied architecture at Winchester, and later on he spent five years under the well-known Sir G. Gilbert Scott. About 1850 he began to design on his own account, and steadily rose to eminence in his profession. Deeply tinctured with the love of Gothic architecture, which Sir G. G. Scott spent his life in inculcating, his brilliant pupil is conceived by many to have outshone his master in developing a certain original treatment of the style without the slightest departure from its main lines. He wrote and lectured frequently on architecture, and his works on "The Brick and Marble Architecture of North Italy in the Middle Ages" (1855), and "Some Account of Gothic Architecture in Spain" (1865), are reckoned as authorities on the subject of which they treat. Mr. Street received the honour of election to

the Royal Academy as Associate in 1866, and as full Academician in 1871. The Vienna Academy elected him a member in 1869, and the French government bestowed the Legion of Honour on him in 1878. It would be a mere catalogue to enumerate the churches and other large buildings that Mr. Street restored in a busy life; but the excellent work at Jesus College Chapel, Cambridge, carried out exactly along the line of safety between true restoration and alteration, the rebuilding of the nave and two western steeples of Bristol Cathedral, and the nave and choir of Christ Church Cathedral, Dublin, must be noticed as models of how this necessary and important class of work should be undertaken.

When Mr. Street won the competition for the design of the new Law Courts in 1868 (his old master Sir G. Gilbert Scott being among the defeated), he gave up his life to this great work. He designed everything, down to the knockers and door handles; and the result is the most complete specimen of modern Gothic that the country can show. Moreover, it has vindicated the often denied power of the Gothic style to adapt itself to varying circumstances, for it is eminently suited to the work it accomplishes; and in spite of occasional grumbles over draughts, &c., on the part of the judges, all who have to use the noble pile of buildings are really proud of its finished appropriateness. It is generally believed that the constant work and worry over the great building shortened Mr. Street's life; so that he died at the early age of fifty-seven, on the 18th December, 1881, when the mighty palace of justice, by which he will be remembered, was on the point of completion.

STREL'ITZ (properly *Streltzi*), a famous national guard of Russia, which rose to the power of the Prætorians of the Roman Empire and the Janissaries of Turkey; and like those two bodies had to be crushed to save the state from being crushed by them. They originated in the Opritchniks of Ivan the Terrible, who, after the death of his wife in 1560, changed from one of the wisest of rulers into a veritable scourge of his country. His famous bodyguard, the only military force in Russia, spread terror through the land, acting in blind obedience to the tyranny of their sovereign. In return they were almost inviolable, and had countless privileges. Gradually they became organized into the Streltzi or militia guards, the standing army of the Russian Tsars, and their number was usually nearly 50,000. They had a large quarter allotted to them in Moscow, and between privileges conferred and assumed, they enjoyed a practical independence among themselves. In consequence they were in frequent revolt, and their quarters were a hotbed of conspiracy. At length the danger of such a force came to a climax under Peter the Great. Peter's sister Sophia had ruled during his minority, and was unwilling to give over the reins of government. She intrigued so persistently when her brother had assumed the sovereignty, that he was compelled to imprison her. From her prison she corrupted the Streltzi, and a most formidable rising followed. Peter was absent, and his generals had already made head against the revolt when he arrived in Russia, having hurried home from Vienna in absolute secrecy. His first measure was to put to death all the officers, including the priests. Then 2000 of the rank and file were hung on the walls of the city, or otherwise put to death, even with barbarous punishments. Two women were burned alive (1698). The rest, with their families, were banished from the capital to Siberia and to Astrakhan. Further insubordination in the remnant of the force retained by Peter at Moscow was punished by its extermination in 1705.

STREL'ITZ, MECKLENBURG. See MECKLENBURG.

STRELIT'ZIA is a magnificently flowered genus of the order Musaceæ, named after Queen Charlotte (of Mecklenburg-Strelitz), and consisting of large herbaceous plants, natives of the Cape of Good Hope. Their long-stalked glaucous leaves are sheathed at the base, and spring from a contracted stem. The flower stalk is encircled below by the sheath of the leaf stalk, and terminates in a large spathe containing the flowers. The perianth has six segments, in two rows; the three outer (sepals) are ovate, lance-shaped, nearly equal, and of a bright orange colour; the three inner (petals) are unequal in size, the two front ones bright purple, united together, each one lobed on the outer side, so that the two united petals are distinctly halbert-shaped; the third petal is much smaller and somewhat hooded. There are five perfect stamens, and one barren; the style is thread-like. The fruit is a three-celled capsule, containing numerous seeds, which have an orange-coloured tuft of hair attached to them.

Several species are cultivated for the beauty of their foliage and flowers. *Strelitzia reginæ*, the finest species, has large orange and purple flowers. Its seeds are eaten by the Kafirs.

STRE'NA, a festival-present among the Romans. Especially New Year's *strenæ* were due between friends, and from inferiors to superiors. The Senate formally decreed that the New Year's offerings to the Emperor Augustus must be punctually made in the Capitol, whether the emperor was in Rome or not. In fact, the strena became a sort of tax. The modern French *étrennes* of New Year's day are derived both from the word and the custom of the *strena*, and have become even worse in the extent of their exactions. In any great antiquarian museum many of the lamps and such decorative articles are by their inscriptions shown to be *strenæ*.

STRENGTH OF CURRENT, in electricity, is measured in AMPERES, and is tested by ELECTRIC METERS. Strength or intensity of current must be confounded neither with "quantity of electricity," measured by coulombs, nor with "electro-motive force," measured by volts.

STRENGTH OF MATERIALS. See MATERIALS, STRENGTH OF.

STREPSIP'TERA. See STYLOPIDÆ.

STRET'TA, in music, a coda or final passage taken quicker than the *tempo* of the general movement; short for *coda stretta*, or "drawn-together coda," and not to be confused with STRETTO.

STRET'TO, a famous device in counterpoint. The word is Italian and means "contracted" or drawn together. Therefore when, in pieces of IMITATION or in FUGUE, the subject and its imitation or answer are made to overlap, a stretto is produced. Some subjects bear more than one stretto, and in this case the stretto containing the greatest overlapping is considered the "closer" or finer. In fugue when one stretto is imperative, and more than one are often found, the closest stretto is usually reserved for the last. An example of a stretto is appended, taken from Bach's four-part fugue in C major, the first of the immortal "Forty-eight":—

Where the subject is the following theme,

and the stretto is formed by the answer in the tenor (*b*) striking in upon the subject in the alto (*a*) at its third

note. Then the bass (*c*) cuts in with the subject upon the tenor after the subject proper is done in the tenor, but while the usual continuation of it is yet going on, and finally the soprano (at *d*) strikes in at the fifth note of the subject as given in the bass.

STRICKLAND, AGNES, authoress, was born in 1806, of a Suffolk family, a branch of the Westmorland Stricklands. She was the third of six daughters, who were carefully educated by their father, Mr. Strickland of Reydon Hall, Suffolk. She had been an authoress for many years when, in 1840, she commenced the publication of an extensive work (in the preparation of which she had been assisted by her elder sister Elizabeth), the well-known series of historical biographies, "Lives of the Queens of England from the Conquest to the death of Queen Anne." It was completed in 1851; and from 1850 to 1859 appeared her "Lives of the Queens of Scotland and English Princesses connected with the regal succession of Great Britain," opening with Margaret Tudor, the queen of James IV., and closing with Sophia, electress of Hanover. Another of Miss Strickland's contributions to historical biography was the "Lives of the Bachelor Kings of England," published in 1861. She died in 1874. A most interesting memoir of her, by her sister and colleague Elizabeth, appeared in 1887.

STRICT STYLE, in music, is that severe mode of writing which applies certain rigid laws to all notes of the scale alike, regarded as roots or parts of chords, which excludes all but diatonic notes (*i.e.* which excludes chromatic harmonics), and refuses to admit unprepared discords or passing notes, approached otherwise than by step.

Strict imitation, in music, in like manner, is that which demands an exact copy of the subject in the answer or imitation; whereas ordinarily, to allow of greater freedom in writing, a moderate license is given, provided only that the general character of the subject, if not its precise intervals, be reproduced in the imitation sufficiently nearly for it to be readily recognized.

STRIC'TURE is the term employed in surgery to denote an unnatural contraction of any tube, duct, or orifice, which may occur as the effect of disease or injury, and more especially such affections of the urethral canal. When the term is used in a general sense, and a person is said to suffer from stricture, the reference is always to the urethra. Stricture of the urethra may be either spasmodic, inflammatory, or permanent. Spasmodic stricture is of frequent occurrence in persons who have an irritable urethra, so rendered by frequent inflammatory attacks, or who have some slight permanent stricture, and the symptoms are apt to come on after indulgence in alcohol, through irritation of the lower bowel, through a chill, or after prolonged horse exercise. In such cases there is a great desire to void the urine, together with an inability to do so, the bladder becomes distended, and if relief is not obtained there is danger of rupture of the urethra and extravasation of the urine. The treatment of spasmodic stricture consists in the removal of irritation and congestion by suitable salines and purgatives, the use of a hot hip bath, and if necessary the discharge of the urine by means of a catheter. Inflammatory stricture is due to the swelling of the deeper part of the urethra during inflammation, and it is a not unfrequent complication of acute gonorrhœa. It also occurs as a result of the use of stimulating injections which have been resorted to to check the discharge attending that disease. The local treatment of this affection consists in the use of a small flexible catheter to relieve the more urgent symptoms, and of saline purges, rest, warm baths, and opiates. Permanent or organic stricture is caused sometimes by external injury, such as that arising from a severe blow, a fall across a beam of wood or other hard body, or from the accidental puncturing of the peritoneum; but in the larger number of cases it is the result of long-continued inflammation of the submucous tissue following gonorrhœa. It is generally gradual in its formation, and is not usually noticed until long after the exciting cause has disappeared, an interval of several years being frequently observed between the subsidence of the inflammation and the appearance of the stricture, and by the time surgical advice is sought the affection is usually pretty firmly established. The symptoms of permanent stricture are difficulty in micturition, pain, an alteration in the stream of urine, a frequent desire to pass urine, the presence of a slight urethral discharge, and occasional attacks of complete retention of urine. The contraction of the canal may occur in any part of its length, and the new tissue which causes it is developed in a variety of forms, sometimes more than one stricture being observed at the same time. In the treatment of this affection both constitutional and mechanical means have to be employed. As regards the former all causes of functional disorder arising from the habits and diet of the patient must be removed. Strict temperance in alcoholic drinks, in stimulating or highly nutritious foods, and in some forms of exercise, such as horse or bicycle riding, must be enforced. Due attention to the skin and bowels, and sufficient bodily exercise, with the use of alkaline remedies, are also requisite, and such measures will do much towards assisting the mechanical measures which may be deemed necessary. The latter include methods of gradual dilation, secured by passing during a series of sittings sounds or flexible bougies through the stricture, the size of the instrument being gradually increased; gradual continuous dilation obtained by the retention of a series of flexible catheters; and the division of the obstruction by forcible dilation or divulsion. Other methods formerly employed, such as the use of caustics or the cautery, have now fallen into desuetude. In every case experienced surgical advice should be secured as soon as possible, and as a rule much skill and patience will be necessary to secure a permanent cure.

STRIG'IDÆ. See OWLS.

STRIG'IL (Lat. *strigilis*), the Latin equivalent for the Greek *stlengis*, the scraper used by the ancients of both sexes in their baths for cleansing the limbs. Strigils were generally hollowed out in the shape of a shallow spoon. They were made of various materials, such as metal, horn, bone, and reed, and provided with a handle, and were of various curves and lengths to accommodate various uses. The exquisite statue of the athlete in the bath, which is found at the Vatican Museum, Rome, and is called the *Apoxuomenos*, is in the act of using the strigil. The hot air of the Greek and Roman baths (like our modern Turkish baths) caused a copious perspiration to pour from the pores, carrying with it all impurities and clearing the skin of its outer worn-out portions. To remove these was the office of the strigil.

STRIKE (Ger. *streichen*, to extend), a term used in geology to denote the direction of horizontality of inclined strata. It is an obviously imaginary line drawn at right angles to the maximum slope (or DIP).

STRIKES and LOCK-OUTS. See TRADES UNIONS.

STRIKING REED or *Beating Reed.* See REED INSTRUMENTS.

STRING, in music. See STRINGED INSTRUMENTS.

STRING QUARTET. A string quartet is a piece in sonata-form, written for first and second violin, viola, and violoncello. If two violoncellos are used we have a string quintet, or if only one violin is used we have a string trio.

The phrase *string quartet* is often used in connection with the orchestra to signify the parts written for the violins, viola, violoncello, and contrabasso, the two last being reckoned as one, because of their usually playing in octaves, and from the same copy. Another equally common term for the same division of the orchestra is "strings."

The "strings" are always held to form the basis of all orchestral music. See **Instrumentation**, **Violin**, **Viola**, &c.

STRING-COURSE, a projecting *course* of masonry forming a *string* or horizontal line on the face of a wall, and consisting of a series of mouldings, as in Gothic, or a flat surface (either plain or enriched), as in Italian architecture. In both styles string-courses admit of great variety, and contribute very much to decoration. At the same time they are in themselves essential members, inasmuch as they serve to define the internal division of the building, corresponding with the floors of the several storeys; and by separating one tier of windows from another, to mark each as a distinct portion of the entire composition, complete as regards itself, though secondary to the general whole. While they separate, they serve also to connect and combine the successive stages of a building, and to produce a due admixture of horizontal with perpendicular lines. In Gothic architecture the upper surface of a string-course is almost invariably splayed or sloped in order to shoot off rain, the projection being usually such that the wet would otherwise lodge upon it. The string-course itself consists sometimes of only a few narrow and plain mouldings, at others of a variety of them separated by one or more considerable hollows. In the later or Perpendicular style of Gothic it is frequently made a broad tablet, not only richly moulded, but ornamented with sculptured blocks, heads of animals, shields, &c., placed at intervals in the principal cavetto or hollow. In Italian architecture the string-course (*fascia*, Ital.; *cordon*, French; *band*, German) is either quite plain, or more or less decorated, according to the character of the floor to which it belongs.

STRINGED INSTRUMENTS of music are those which depend upon the vibration of a sounding string for their musical properties. The materials of the string are very various, the two chief varieties being catgut (really the gut of the sheep, not of the cat) and wire. Instruments meant to be played by the finger, as the harp, the guitar, the lute, lyre, banjo, &c., have catgut strings, as have also the great family of bowed instruments, the violins, in all their forms. In all these instruments, however, the bass strings are weighted with metal, which is spun round them in a close spiral, rendering it possible to get a very deep tone without an unwieldy string. The deeper the tone of the string the thicker and denser should the string be. The basis of the covered strings of the guitar is silk, instead of catgut, and the same material has been tried for violin strings, both covered and uncovered, but without success. Among savage races the fibres of trees, the hair of animals, slender threads of cane, and leather thongs, are the materials for strings.

Those instruments which, like the pianoforte, the dulcimer, and the zither, are played with hammers or with a plectrum, have metal strings, either of steel or of steel covered with copper. Brass, formerly largely used for bass strings because of its deep sonorous tone, is now discarded because of its ringing, clanging quality, which presents so marked a contrast to the clear brilliant incisiveness of steel that an even tone throughout the instrument is impossible when the two are used in conjunction.

In all stringed instruments the tone, which is given forth by the string, and is in itself too weak to be of much musical use, is strengthened to a very great extent indeed, and is at the same time altered in quality, by connection with a belly or sound-board, the office of the latter being to receive the sonorous wave by direct contact, and then to reflect it from a broad and easily vibrating surface. The modes of contact are very various.

In the harp the strings are pegged into the sound-board at their lower extremity, and when tuned and brought into tension (the tuning pegs being along the upper line of the harp frame), they therefore exert a direct pull on the sound-board. On being set into vibration they communicate that vibration to the sound-board by a series of pulls and releases, throwing its whole surface into sympathetic resonance, and producing a sound-wave of great size and force. It is at once manifest that the material of the sound-board, its thickness or thinness, its mode of attachment to its frame, &c., must exercise an important influence upon the final result, for we hear far more tone from the sound-board than from the original string; nevertheless the material of the string, by governing the original vibrations, controls the vibrations of the sound-board. In fact the resultant sound is a combination from the two sources. This applies to all stringed instruments alike; but the mode of attachment of the string directly to the sound-board, as above described, is peculiar to the harp, and the effect upon the tone is most marked. The pizzicato (tone produced by plucking) of the violin, the guitar, and the banjo, is altogether different from that of the harp. The peculiar throb which accompanies each harp-sound is at once recognizable, even if there be only one harp in a large orchestra; and it is one of the most beautiful, as it is one of the most strongly-coloured, varieties of musical tone. A pathetic air, sung to a harp accompaniment, which sobs out, as it were, its penetrating harmonics, cannot be excelled for intensity of effect.

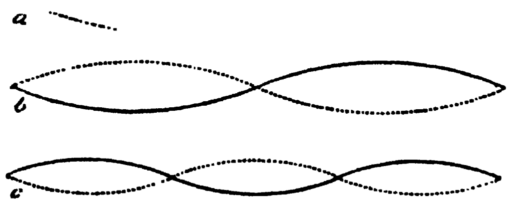
Practically all other stringed instruments communicate the vibrations of the string to the sound-board by means of bridges. The string is fastened to the framework of the instrument at its lower, and to the tuning-pin at its upper end, usually passing over a nut or upper bridge just before reaching the pin, so as to mark off sharply and decisively the sounding portion of the string. Thus stretched the string lies horizontally above the sound-board, but as yet has no connection with it. This is gained by a bridge standing upon the sound-board, and tall enough to strain the string upward from the horizontal as it passes over it. If there is more than one string the bridge is made long enough width-ways to carry all the strings, so that it becomes a very long strip of wood in such instruments as the pianoforte. When the bridge is thick enough to show any appreciable "table" or upper surface, as in the pianoforte, this receives a row of pins so arranged as to strain the strings sideways, their function being to mark off the sounding part of the strings more sharply than so thick a bridge would do if left to itself. But in violins, guitars, &c., the bridge is quite thin, and no such arrangement is necessary.

The sound-board of the pianoforte, guitar, lute, dulcimer, zither, and harp is of wood and flat, or nearly so; the sound-board of violins rises in the middle, so that it forms, as it were, a low-crowned arch, and is better able to bear the thrust of the bridge. All these instruments have bars beneath the sound-board to strengthen it against the thrust of the string. The banjo, the Siamese fiddle, and a few other stringed instruments belonging to savage nations, have vellum or skin "bellies," answering to the sound-board of the more perfect instruments. The ancient lyre of the Greeks had either a skin sound-board or a bony one, its sound-box being the shell of a tortoise and its belly being sometimes made of the ventral plates of the animal's bony covering. It had a flat bridge like the guitar. The kithara of the Greeks had a sound-board of wood or of metal.

Whether plucked by the finger (with or without a plectrum), as the harp, lyre, lute, guitar, &c., or played with a bow, as the violins, or struck with a modified drumstick, as the dulcimer, or struck by a hammer moved by a system of levers, as the pianoforte, the vibration of the strings which gives the tone to stringed instruments follows the same laws. A string sounding its proper note or prime tone, which is the lowest note it can be

made to sound, vibrates in long swings, as at *a* in the figure.

It is practically impossible to get sounding strings to vibrate thus, but we know by analogy that if we heard such a string it would give a dull pure tone something like that of a tuning-fork or a stopped organ-pipe. The best way to demonstrate the fact is by a long close spiral of wire gently stretched, whose vibrations are easily excited and can be seen by a large number at once. If such a string be swinging, as at *a*, and the finger touch it in the middle, it will change its vibration to the form *b*, with one node or rest-point and two ventral segments. Were such a figure possible to produce on a sounding string the note given forth would be the Octave of the prime tone. A division into three ventral segments divided by two



Vibration of a Stretched String.

nodes, as at *c*, would give the Twelfth (Octave and Fifth) of the prime tone, and one into four segments, as at *d*, the Fifteenth (double Octave) of the prime. Actual sounding strings do not take up any one of these wave-figures singly, but combine them, and generally two further modes of vibration at least along with them, namely, vibration in five and in six segments. The effect upon the ear is consequently that of a chord of several notes sounding at once, the prime tone predominating so far as to give the pitch, the upper tones melting into it and giving the quality. If there are many modes of vibration combined at once in the complex curve of the string, the tone is full and ringing; if the lower tones (the simpler modes) be the more vigorous, as in the double bass, it is rich and heavy, and if the higher tones be very prominent, as in some violins, it will be clangorous and penetrating as a trumpet. Over-strong upper partials produce what is called a *poor* tone. Very fine metallic strings give as many as sixteen modes of vibration, and their tone is very glittering and bodiless—what is generally called tinkling. It may be doubted that these modes of vibration are really occurring at once, but the fact is readily demonstrated by the use of RESONATORS, each of which readily sorts out its own note from the mass of upper partial tones. It is advisable to read the article ACOUSTICS in connection with this paragraph.

A moment's reflection will show that where a string is plucked or struck there no node can exist. Consequently if a string is struck at its middle the second, fourth, sixth, and all even modes of vibration are eliminated, for these require nodes at the middle of the string; and the effect on the tone is disastrous. So, also, striking a string at a third of its length eliminates the third, sixth, and ninth modes of vibration, which all need nodes at that point, and again the tone is rendered thin and characterless. The "striking-point" is therefore a matter of great consideration in the manufacture and playing of stringed instruments. A seventh of the length is found to be a good point, as in our modern tempered tonality the natural seventh is not used. (This is what is often termed the SUBMINOR SEVENTH.) Further, only the seventh and fourteenth modes of vibration are disturbed, for no others require that point as a node.

The way in which the string is set in motion on a bowed instrument, such as a violin, is, of course, by the sideway dragging of the string from its normal position as the bow is drawn across it. This drag is rendered more powerful by rubbing the hair of the bow with resin, which "bites" the string. The bow drags the string till its tension is greater than the bite of the bow, when it flies back, and the operation begins again. The form of the wave can be actually seen by fastening a number of small wires along a violin-bow, as if it were a comb, and looking at a dot of white upon the string, seen at an angle through the grating thus formed. As the bow, with its wire-comb attachment, is drawn across the string the dot describes a rapid series of zigzags; and these, upon examination in instruments

Vibration of a Violin String (quarter length).

such as the VIBRATION MICROSCOPE, which admit of more scientific scrutiny, are found to be a wave-system where the length of the rise of the wave is to the length of its fall as the two portions of the string on each side of the moving dot of white are to each other. The form of wave above given is true for the white point placed at a quarter the length of the string, when the rise of the wave is three times its fall. If the white dot be placed at the middle of the string the rise and fall of the wave are equal

Vibration of a Violin String (half length).

in length. An astonishing effect is produced by the least "scrape" or "scratch," due to unskilful bowing, which may occur while the string is under observation; for, while perfect bowing on a fine Cremona instrument will give the vibration figures here shown (except that the lines in the actual experiment are delicately crinkled instead of being rigidly straight), imperfect bowing causes sudden jumps and even complete changes in the figure, and a very scratchy tone causes such rapid variations of figure as to be no longer recognizable as a definite form. Every little stumble of the bow is thus visible to an observer, and sometimes inequalities of tone are seen which would not be heard by the most critical hearer without the assistance of the eye; while on a poor fiddle the most careful bowing sometimes fails to educe a perfect figure. Here we have the scientific proof of the importance of smooth bowing in the production of pure tone, practically known to every violinist, and also the reason of the superiority of high-class violins; in each case it is the regularity of vibration in which lies the charm.

In the pianoforte and the harp the lengths (that is, the sounding lengths) of the strings vary considerably. The treble strings are quite short, and the bass strings are as long as the instrument allows. But in violins, &c., all the strings are of the same length, and yet their pitch, under equal tension, varies very considerably. This brings us to the consideration of the string as controlling the pitch; and the following are the principal laws governing this relation:—

(1) Strings of the same length and at equal tension vibrate inversely as the square roots of their mass. That is to say, one must increase the weight of a string four

times to obtain (under like conditions) vibrations of twice the length, and therefore of half the frequency—in other words, to obtain the sub-octave. Hence the necessity of "covering" with metal the bass strings of most instruments; for without such weight-giving covering it would be necessary to use such thick strings to get the needful pitch that if they could be sounded the quality of the tone would suffer, while for practical reasons it would be usually impossible to play them.

(2) Strings exactly alike and of the same length, but of varying tension, vibrate as the square root of the tension. So that with four times the tension we get twice the rapidity of vibration, and consequently sound the super-octave.

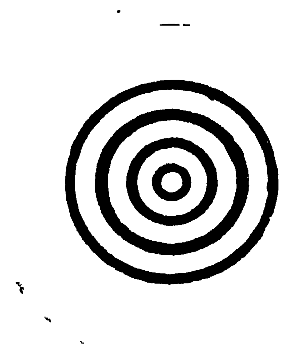
(3) Strings exactly alike and at the same tension vibrate with a rapidity inversely as their length. Thus, of two strings exactly alike in all other respects, the one which is twice as long as the other vibrates half as fast, and (which is the same thing otherwise expressed) sounds an octave below it.

This last law lies at the foundation of "stopping." If the string of an instrument be made to pass above a finger-board for part of its length, then the finger can press it against the finger-board and "stop" it, or throw part of it out of vibration. It is evident that if the string is thus "stopped" at a third of its length only two-thirds of the string is permitted to sound; and by the rule above this means that the vibration rate of the shortened string will be as three to two compared with that of the whole string, which will give the note a Fifth above the prime tone. On experiment this is found to be the case. Carrying the same principle onwards the violinist can easily produce an octave of notes on each string, and it is this facility which gives the class of violins its pre-eminence. The harpist, like the ancient lyre-player, uses the entire string, which, however, by an ingenious mechanism, worked by the foot, he can shorten at will, so as to give a semitone or a tone higher than the original note. Most of the other stringed instruments with finger-boards have frets, like the guitar, small raised bars of metal or wood running athwart the finger-board (or, as in the ancient Egyptian lute, a string tied round the finger-board), the use of these frets being to assist the performer by dividing the scale for him. In many instruments the performer presses the string behind the fret; in some he presses it down upon the fret. The violin is almost alone in having a free finger-board, and is thereby enabled to produce the minutest shades of variation of pitch, and to glide from one note to another in a manner accomplishable only by it and the human voice, the latter being the most perfect of all musical instruments.

STRINGEN'DO, a musical term, literally meaning in Italian closing together, but used to denote a quickening of the tempo and pressure onwards towards some climax, the notes closing together like a crowd who tread on each other's heels in their hu .y to get forward to a wished-for goal.

STRINGS or **STRINGED ORCHESTRA.** See String Quartet.

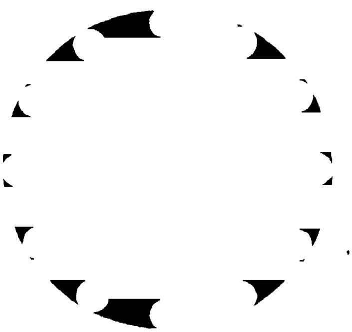
STRO'BIC CIRCLES. If a pattern, such as that given in the illustration following, be formed of concentric circles, it will be found to present some remarkable illusory features. First, if it is steadily looked at as it lies at rest on the page, it will soon begin to quiver with motion, now here, now there. Then if the eye is moved from side to side, or up and down across the figure, it will appear to partially rotate, and a hazy wide cross-line will appear in the direction the eyes are moving in. Third, if the book be moved rapidly backwards and forwards, or from side to side, the figure will seem flattened or gibbous from top to bottom in the first instance, and from side to side in the second, or in technical language will be prolate or oblate respectively. Also when prolated in this fashion the top and bottom quadrants (by which is meant, of course, the quadrants nearest to the top and to the bottom of the page) will appear blurred, while, when oblated, the side quadrants are blurred. Finally, a most astonishing result



Strobic Circles.

follows the rotation of the figure in a horizontal plane (as one swings liquid in a saucer), for at once the circles all seem to move in the direction of the rotation, while a hazy cross rotates in the same direction above the whirling (strobic) figure.

Another strobic figure is produced by drawing a strongly defined circle and placing dots round the inner margin of it at equal distances, as in the subjoined figure. On rotating this in a horizontal plane (in very small rapid circles) the dots will be seen apparently to move round the inner margin of the large circle in a direction opposite to that of



Strobic Figure.

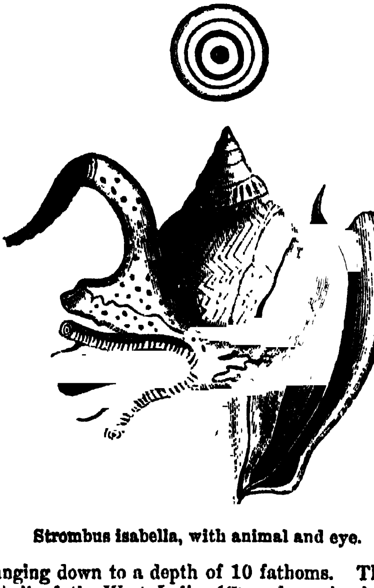
the rotation. If the circles of rotation are made wider the dots will form striated lines in a beautiful shell-like figure of fixed form, or will appear to move out and in in the figure like the device called "engine turning." The illusions are more perfect when separately drawn and on a larger scale, and especially when they are mounted on card.

STROH'FIEDEL or **STRAW-FIDDLE,** a musical instrument formed of sounding plates of wood or of glass arranged along belts of twisted straw, whence the name. It is, in fact, a variety of the harmonicon. It is played by hammers like a dulcimer. The variety with wooden plates is by far the most harmonious, because the piercing high par-

tial tones are allowed to die out more quickly, owing to the porous nature of the material. The principal instruments of the Siamese and Javese orchestras are of this kind, and the plates are arranged on the upper edges of curious boat-shaped vessels, with pegs to keep them in place. In every case the plates must be free at the ends and supported at the nodes.

For so rude an instrument the strohfiedel is capable of much development. Mendelssohn speaks of a certain Gusikow as a great performer; and he played quartets with two violins and a violoncello. The Siamese performers at the International Exhibition of 1885 produced marvellous effects by rapid repetitions and running passages.

STROM'BIDÆ is a family of molluscs belonging to the order GASTEROPODA and section Siphonostoma. The shell is solid, spiral, with a widely expanded outer lip, which is lobed above, and deeply notched near the canal. The operculum is horny, claw-shaped, and serrated on the outer edge. The Strombidæ (or wing-shells) are active, muscular, and predaceous animals, using their operculum as a weapon of defence. The foot is narrow and not adapted for crawling, but these molluscs progress by a kind of leaping movement, rolling their shells from side to side. They have large and well-developed eyes, situated on thick stalks. The species are numerous, chiefly natives of tropical seas. They are found on reefs at low water,



Strombus isabella, with animal and eye.

and ranging down to a depth of 10 fathoms. The Fountain Shell of the West Indies (*Strombus gigas*) is one of the largest living shells, weighing sometimes 4 or 5 lbs. The animal is occasionally used as an article of diet, and the shell is extensively used in the manufacture of cameos. Immense quantities are annually imported from the Bahama Islands for this purpose, and for the porcelain works, 800,000 shells having been in one year imported to Liverpool alone. The Scorpion Shells (Pteroceras), which also belong to this family, are so called from the shape of the shell of the adult, which has the outer lip produced into several long claws, one of which joins the spire and forms a posterior canal.

STROM'BOLI (*Strongyle, i.e.* the round), the most northerly of the Lipari Islands, 45 miles west of the coast of Calabria, Italy, is in form very irregular, and consists entirely of a single volcanic mountain, 3080 feet in height, of which the centre is occupied by the ancient crater, the present crater being situated on the north side. It is continually discharging flames, which during the night can be seen at a great distance, and also, occasionally, stones and ashes; but for nearly 2000 years has made no eruption, properly so called. There are one or two villages at the foot of the mountain, and some patches of exceedingly fertile soil, producing excellent cotton, wine, and fruit. The shore is lined with cliffs of pumice.

STROM'NESS, formerly *Cairston*, a small town of Scotland, in Orkney, situated 12 miles W.S.W. of Kirkwall, on the island of Pomona, beside a beautiful bay, with a harbour, the best in North Scotland, which admits large vessels, and has two patent slips and fine pier, opened in 1879. There are a museum, reading-room, and court-house, and a parish, Free, and U.P. church. Stromness was long in litigation with Kirkwall with reference to the right of the latter town to exact a ruinous cess. Such a right was ultimately held not to exist, and this decision freed all the villages of Scotland from the claims of the royal burghs. It admits vessels of all burdens, and 100 sail have been anchored here at one time. The mail steamer sails from this port. The town is a burgh of barony, and had 1705 inhabitants in 1881, some of whom are employed in boat and ship building. There are also three distilleries, producing 20,000 gallons of whisky annually. The population of the parish was 2410.

STRONGYL'IDÆ is a genus of parasitic worms belonging to the class NEMATODA or thread-worms. The Strongylidæ are found chiefly in the bronchial tubes and kidneys of mammals, but rarely in man. *Eustrongylus gigas* is the largest nematode worm known, the female being 3 feet long and about half an inch broad at the thickest part. It inhabits the pelvis of the kidney of the seal, otter, weasel, and other mammals, causing disease and sometimes death. It very rarely infests the human subject. The Lung Worm (*Strongylus micrurus*) is found in the bronchial tubes of calves, passing its earlier stages in the earthworm. An allied species inhabits the bronchial tubes of sheep. The Palisade Worm (*Strongylus armatus*) is a dangerous parasite of young horses, making its way from the stomach through the tissues into the bloodvessels, and thence into the intestinal canal. Another species of Strongylus (*Strongylus pergracilis*) is parasitic in grouse.

STRON'TIUM, the metal of the alkaline earth strontia. It was first discovered as a native carbonate in 1787 at Strontian, in Argyllshire, and was mistaken for barytes. Dr. Hope demonstrated its distinct character in 1792, and the metal was first obtained by Sir H. Davy in 1808. It is found native as strontianite, the carbonate, and as cœlestin, the sulphate; it is also present in small quantity in aragonite and some other minerals, and in sea water and several mineral waters. The pure metal is easily obtained by electrolysis from the chloride. It has a yellow colour, and a specific gravity of 2·5418. It oxidizes rapidly in the air, and burns when thrown on water, forming in both cases strontia. The symbol of strontium is Sr, the atomic weight 87·5. The principal oxide of strontium is strontia (SrO). This is a hydrated peroxide, obtained in scales by mixing strontia water with peroxide of hydrogen.

Strontia may be obtained by heating the nitrate or carbonate. It is a white infusible substance, glowing with an intense white light when strongly heated. When moistened with water it becomes heated and falls to powder like lime, and forms the hydrated oxide (SrH_2O_2). This hydrate in solution deposits crystals having the formula $SrH_2O_2 8H_2O$. These deliquesce on exposure to the air, and become carbonated. The crystals are soluble in 50 parts of cold and 2·4 parts of boiling water. The solution, called strontia water, is strongly alkaline.

Chloride of strontium ($SrCl_2$) forms a vitreous mass when fused. From solution in water it crystallizes in deliquescent needles, having the formula $SrCl_2 3H_2O$.

Bromide of strontium ($SrBr_2$) also crystallizes in needles,

having the formula $SrBr_2 3H_2O$. The iodide also crystallizes in a similar form. Fluoride of strontium (SrF_2) is an insoluble white powder.

There are several sulphides of strontium. The monosulphide (SrS) is a white powder. The tetrasulphide (SrS_4) forms brownish-red hygroscopic crystals, which by exposure form red rhombic crystals of the oxytetrasulphide ($SrO\,SrS_4 12H_2O$). The pentasulphide (SrS_5) exists in solution only. The sulphydrate (SrH_2S_2) crystallizes in prisms. It is obtained by saturating strontia water with sulphuretted hydrogen.

Sulphate of strontium ($SrSO_4$) occurs native as cœlestin. It is a white insoluble powder, which melts at a red heat to a vitreous mass. It is soluble in 9638 parts of boiling water, and the solution precipitates salts of barium.

Nitrate of strontium ($SrNO_3$) crystallizes in octahedrons. It is very soluble in water, and a hydrated salt crystallizes with five equivalents of water. It melts at a red heat and decomposes, leaving strontia. When thrown on red-hot coal it detonates and burns with a crimson flame.

Strontium compounds are easily distinguished by colouring the outer flame of the blowpipe crimson red. Alcoholic solutions of strontium salts burn with an intense crimson flame. Spectrum analysis shows a bright red line and a bright blue line, which enable the smallest trace of strontia to be detected. In solution the reactions resemble those of barium, but the sulphate is not quite so insoluble, and its precipitation not so immediate as that of barium. It is also distinguished from barium by giving no precipitate with potassium chromate.

The salts of strontia, particularly the nitrate, have long been extensively employed in pyrotechny. In red port fires and in signalling the use of strontia is essential. Recently strontia water has come into use in the manufacture of sugar. Advantage is taken of the compound formed with sugar, and known as strontium saccharate, which crystallizes out from the syrup; it is then dissolved in water and the strontia separated as carbonate by passing carbonic acid through the solution. It increases the yield of available crystalline sugar.

STROOD, a small town of England, in the county of Kent, 31 miles from London, is a continuation, on the other side of the Medway, of the city of ROCHESTER, to which it is joined by a bridge, and within the limits of which this town is comprised. The population in 1881 was 5566. Here are stations of the South-eastern, and London, Chatham, and Dover railways, the latter crossing the river by a tubular iron bridge.

STRO'PHE (Gr. *strophê*) is a set of verses composed according to a certain system of metres. The word is derived from Gr. *strephô*, to turn, for in the lyric poetry of the Greeks, especially the choral, this part of a poem was sung during the movements and dances of the chorus. In modern times such a combination of verses, written either in the same or in different metres, is commonly designated by the Italian name *Stanza*. The division of a poem into strophes was, however, applied by the ancients only to lyric poetry, and here one strophe seldom exceeded four verses (lines), with the exception of the dramatic and other choruses, in which it sometimes contains a considerable number. However different the metre of the several verses may be, there is always a unity of rhythm in them which characterizes a strophe as an artistic whole. The choral poems of the Greeks generally consisted of three main parts—stro'phe, antis'trophe, and ep'ode, the *turn*, the *counterturn*, and the *stand*, terms relating to the varying motions of the dancers during the choruses of the drama. The antistrophe corresponds in its metre to the strophe; the epode differs from both, and forms the concluding stanza of a chorus.

STROPH'ULUS is an eruption of pimples upon the skin, which frequently occurs in infants whose health is disordered by the irritation of teething or any other cause. Medical men distinguish the following forms of the disease: (1) *Strophulus intertinctus*, of which the vulgar name is Red-gum or Red-gown; (2) *Strophulus albidus*; (3) *Strophulus confertus*, often called the Tooth-rash, and the Rank Red-gum; (4) *Strophulus volaticus*; and (5) *Strophulus candidus*. These diseases require no active treatment; and cease with the irritation from which they have their origin.

STROUD, a market-town of England, in the county of and 9 miles south from Gloucester, and 102 miles from London by the Great Western Railway, stands in a valley at the junction of two of the streams which form the Stroud Water. The town is the chief seat of the woollen manufactures of Gloucester, and the production is confined to broad cloths of the best description, and all shoddies are rigorously excluded. The jurors of the exhibition of 1862 reported that the cloth from Stroud was the best in the building. The mills are fitted with the newest and best machinery, and many have either been entirely rebuilt or much enlarged—the trade having very considerably extended, though not to such an extent as in some Yorkshire towns. The town is also noticeable as being the chief seat in England for the manufacture of walking, umbrella, and parasol sticks. Several factories are engaged in it. There are malt-houses, breweries, and sulphuric acid and artificial manure works in the town. The site of Stroud was early chosen by clothiers and dyers. Its sanitary condition is good, and a thorough system of drainage has been carried out. There are two churches and places of worship for several bodies of dissenters. The other chief buildings are —a town hall, hospital, corn hall, and subscription room. The population of the town in 1881 was 11,112. Stroud was formerly a parliamentary borough, but its representation was merged in that of the county in 1885.

STRU'ENSEE, JOHANN FRIEDRICH, COUNT OF, a celebrated Danish minister, was born at Halle in Saxony, 5th August, 1737. His father, a divine of some eminence, was professor of theology at the University of Halle, where the son entered in 1754, and applied himself to physic. He obtained his degree of doctor in medicine in 1757. Singular success attended him in the practice of his profession, and in 1768 he was appointed to attend the King of Denmark, Christian VII., in his tour through Germany, France, and England. Struensee soon insinuated himself into the good graces of the king, with whose profligacy his loose principles and easy manners were in perfect accordance. Soon after their return to Copenhagen the king himself presented his favourite to the Queen Caroline Matilda, the posthumous daughter of Frederick, prince of Wales, and sister of George III., and promoted him to the rank of privy councillor. In his capacity of reader to the king, he found ample opportunities of realizing his ambitious plans. He obtained the recall of his friend Enewold von Brandt, the king's chamberlain, who had been banished for calumniating Count von Holck, but who was now raised to the dignity of director of the court amusements. He promoted and apparently effected a more cordial agreement between the king and queen, whose triumph seemed complete; the king behaved to her with deference, and Struensee was now constituted first minister, with almost unlimited power. Thus matters stood at the end of 1770; and in order to be in perfect security, he assigned to Brandt the special office of amusing the king and preventing him from having any conference with his ministers, or interfering in public affairs.

It was about this time that the king, urged by Struensee, dissolved the council of state, and instituted in its place a commission of conference (*Commissions Conferenz*), which consisted of the presidents of the several branches of public administration. This measure brought all the power into the hands of the prime minister, by whom the members of

this new council had been appointed. His authority now became paramount, and no one ventured to oppose him. He then inaugurated numerous financial and administrative reforms, for which, however, the people were not ripe, and the very measures he designed for their benefit only secured him their hostility. Meanwhile the entire confidence of the queen in Struensee was quite unconcealed, and after the birth of a princess in July, 1771, rumours prejudicial to her character spread abroad. The press, to which the imprudent minister had granted uncontrolled freedom, ungratefully turned its influence against him, and became an instrument in the hands of the aristocratic party. An unimportant mutiny of 800 sailors who had not received their pay had already shaken Struensee's firmness, and was followed by a revolt of the Life Guards, whom he had dismissed without any cause. The partisans of Juliana Maria and her son Prince Frederic regarded the critical position of the minister as an opportunity for a *coup d'état* too favourable to be neglected. They planned a conspiracy, and on the morning of 17th January, 1772, Queen Matilda, Struensee and his brother Karl, Brandt, and all their friends and adherents, were arrested. The unfortunate queen was brought to Kronenberg, where she was confined until the end of May, 1772, when she was released through the influence of the English government, and removed to Zelle.

Meanwhile a special commission was formed, in order to try Struensee for high treason, criminal intercourse with the queen, and usurpation of the royal power; and though not an iota of valid evidence was brought against him, he was condemned and sentenced, 25th April, 1772, to be deprived of all his dignities and beheaded. His right hand was to be cut off, his body quartered and broken on the wheel, and his head and hand were to be stuck up on a pole. This sentence was confirmed by the king in every point; and Struensee was decapitated, 28th April, after witnessing the death of his friend Brandt. That he fell a victim to aristocratic malice can hardly be doubted, though his own imprudence in some measure prepared his downfall. Of his innocence with respect to the queen most impartial critics will be convinced. He possessed, as Professor Allen has remarked, singular gifts of intellect; but he lacked the moral earnestness and purity requisite to effect the reforms contemplated by him.

STRUTHIO'NES is an order of BIRDS containing the ostriches, emus, &c. This is a well-marked group, forming a subclass, Ratitæ, to which all other living birds are opposed, as Carinatæ. The name Ratitæ refers to the absence of a keel to the sternum or breastbone, which is therefore raft-like. With this character is correlated the rudimentary condition of the wings, which are not adapted for flight. The feathers are loose and hair-like, being unprovided with barbules, and therefore unconnected with one another. These birds are all terrestrial in their habits, and run very swiftly. They have large feet with two or three toes, except in Apteryx, which has a rudimentary hinder toe. The bones of the skeleton are almost destitute of air-cells.

Four families of living birds are contained in this order, all with very few species: Struthionidæ (OSTRICH, Plate I., fig. 1), Rheidæ (RHEA, fig. 2), Casuaridæ, containing the CASSOWARY (Plate II., fig. 3) and EMU (fig. 4), and Apterygidæ (APTERYX or Kiwi, fig. 5). Several birds now extinct are referred to this order, the most remarkable being the MOA (Dinornis), allied to which is another extinct bird, the ÆPYORNIS.

STRUTT, JOSEPH, an artist and antiquary of considerable eminence, was born at Springfield, in Essex, 27th October, 1742. At the age of fourteen he was apprenticed to Ryland, the engraver, and afterwards became a student of the Royal Academy. In 1773 he published his first work, "The Regal and Ecclesiastical Antiquities of England, containing the Representations of the English Monarchs from Edward the Confessor to Henry VIII." In 1774 he issued the first volume, 4to, of "Horda Angel-Cynnan, or a complete View of the Manners, Customs, Arms, Habits, &c., of the Inhabitants of England, from the arrival of the Saxons;" the second volume appeared in 1775, and the third in 1776. In 1777 and 1778 he published "Chronicle of England," in two volumes 4to. His next work was "A Biographical Dictionary, containing an Account of all the Engravers from the earliest period to the present time, illustrated by engravings," two vols. 4to (London, 1785 and 1786). In 1795, after four or five years' residence in Hertfordshire, he returned to London, and began collecting materials for his "Complete View of the Dress and Habits of the People of England, from the establishment of the Saxons in Britain," published in 1796 and 1799. In 1801 he completed "The Sports and Pastimes of the People of England," 4to. All his works were illustrated by himself. He died in straitened circumstances, 16th October, 1802. He left some manuscripts in the possession of his son, from which "Queen Hoo Hall," a romance, as well as a drama and a dramatic tale, were published. "Queen Hoo Hall" was completed and edited by Sir Walter Scott.

STRU'VE, FRIEDRICH GEORG WILHELM, a distinguished astronomer, was born on the 5th of April, 1793, at Altona, being the fourth son of an eminent Danish mathematician, Dr. Jakob Struve, director of the gymnasium of that city. He studied at the University of Dorpat, where, in 1813, he attained the degree of doctor of philosophy, and was appointed extraordinary professor of astronomy and assistant at the observatory. In 1820 he was promoted to be ordinary professor of astronomy and director of the observatory, which offices he quitted in 1839 to become director of the newly established Russian imperial observatory at Pulkova, near St. Petersburg, which afterwards became famous through his labours. He took a leading part in the measurement of the Russian arc of the meridian, which reaches from the mouth of the Danube to the Arctic Sea, through an amplitude of about twenty-five degrees, or 1500 geographical miles. Among his many astronomical researches perhaps the most remarkable are those on double and multiple stars, and his determination of the parallax of the star Vega, whereby its distance from the solar system is found to be about 800,000 times the distance of the earth from the sun. He died in 1864. In all his later labours he was worthily assisted by his son, Otto Wilhelm Struve, born at Dorpat on the 14th of April, 1819.

STRYCH'NINE, an alkaloid obtained from the bean of the nux vomica, *Strychnos nux-vomica*, natural order Loganiaceæ, in which it exists together with brucine and igasurine. It is also found in other species of Strychnos, especially in the St. Ignatius' bean. It is prepared from nux vomica or St. Ignatius' bean by exhausting the powdered beans with boiling alcohol. The alcohol is distilled off, and the residue in the still is saturated with sulphuric acid, and the solution filtered and precipitated by ammonia, which throws down strychnine and brucine. The brucine is dissolved out by weak alcohol, and the strychnine is recrystallized from boiling alcohol. It crystallizes in small four-sided prisms, having the formula $C_{21}H_{22}N_2O_2$. It fuses without decomposition. It has an intensely bitter taste, and is extremely poisonous. Half a grain has proved fatal in fourteen minutes. It produces tetanic convulsions and rigidity of the muscular system. It is strongly alkaline, and combines with acids, producing crystalline salts, all of which are intensely bitter and very poisonous. It is slightly soluble in water, dissolving in 6000 parts—the solution is very bitter; it is soluble in alcohol, but insoluble in ether. It should not be coloured by nitric acid, thus indicating the absence of brucine. Nitrate of strychnine ($C_{21}H_{22}N_2O_2HNO_3$), and the sulphate

($2C_{21}H_{22}N_2O_2H_2SO_4$), the acid sulphate($C_{21}H_{22}N_2O_2H_2SO_4$), and the acetate, are all employed in medicine in doses of one twenty-fourth to one-tenth of a grain.

The citrate of iron and strychnine, and the citrate of iron, quinine, and strychnine, are scaling salts containing one per cent. of strychnine; both are much employed in medicine in doses of 3 to 10 grains as excellent nervous tonics. The pure alkaloid strychnine is also administered in doses of one-thirtieth to one-twelfth of a grain. In cases of poisoning by strychnine the best antidotes are chloral and bromide of potassium. Strychnine resists putrefaction, and can be found in the body three years after death. It is easily extracted from the contents of the stomach by chloroform. The chloroform solution is allowed to evaporate, and the residue is treated with concentrated sulphuric acid, which chars the organic matter, and again taken up with chloroform. The process is repeated until the solution in sulphuric acid is colourless; the addition of a crystal of potassium bichromate then produces a beautiful and characteristic purple colour. A portion of the residue may be added to a dish of water containing several small frogs, which are particularly sensitive to this poison; these remain quiescent for a few minutes and then suddenly die in tetanic convulsions, which are particularly characteristic. As strychnine has been frequently employed in cases of criminal poisoning it is well to know that it is the most easily detected of all the vegetable poisons, and criminals making use of it have generally been convicted without difficulty.

STRYCH'NOS is a genus of plants belonging to the order LOGANIACEÆ. The species are not numerous, and are found principally in the tropical parts of Asia and America. They are trees or climbing shrubs, with entire, strongly-veined, opposite leaves, and clusters of fragrant whitish flowers. The calyx is four or five lobed; the corolla is tubular, with the limb divided into four or five valvate segments; the stamens are four or five. The fruit is a one-celled, many-seeded berry, the seeds being flattened, disc-shaped, covered with fine silky hairs, and surrounded by pulp. Many of the species contain, in the bark of the root and in the seeds, two alkaloids (strychnine and brucine) combined with a peculiar acid (igasuric acid); these principles have a most powerful action on the nervous system, and may be either invaluable medicinally or act as deadly poisons. The best known species, *Strychnos nux-vomica* is a native of Coromandel, Malabar, Ceylon, and other parts of India, growing in sandy places, and attaining the size of a tree, but short, crooked, and sometimes 12 feet in circumference, flowering in the rainy season. The fruit is about the size of a St. Michael's orange, with a bitter astringent pulp, and containing numerous seeds. The pulp may be eaten, but the seeds are poisonous and officinal. The latter are about the size of a halfpenny, and have a flattened disc-like shape, depressed towards the centre; they are ashy-gray in colour, and covered with fine silky hairs. They form the nux-vomica of commerce, which is used medicinally in the form of an extract or tincture in certain forms of paralysis and indigestion; in small doses it acts as a tonic and diuretic. Nux-vomica acts as a powerful excitant of the spinal cord and nerves, and taken in large doses is a most deadly poison, producing tetanic convulsions and death. The bark possesses the same qualities as the seeds, but in a milder form. The wood is very hard and durable. *Strychnos potatorum* (clearing-nut) is an abundant plant in the woods and mountains of the East Indies. It has shining fruit, which is black when ripe, and is eaten by the natives. The English name is derived from the use made of the seeds, which, when dried, are sold by the natives for the purposes of clearing muddy water. *Strychnos Ignatii* (St. Ignatius' Bean) is a climbing shrub, without tendrils, bearing long drooping white flowers, which have the scent of jasmine. It is a native of Cochin-China, the Philippine Islands, and other parts of Asia. The seeds are used in India as a remedy against cholera. *Strychnos colubrina* (Snake-wood, or Snake-poison Nut) is a native of the coast of Coromandel and Silhet. It has small greenish-yellow flowers, and fruit as large as an orange, of a yellowish colour. It is considered by the Indian doctors as an effectual remedy for the bite of poisonous snakes, and is also used in fevers, &c. Some other Asiatic species are said to furnish antidotes against snake-bites. *Strychnos Tieute* (Tjettek or Upas Tieute) is a climbing shrub, a native of Java, and is said to be the true Upas tree of that country. It is a most poisonous species, and yields a large quantity of strychnine. A decoction is used by the natives of Java with which to poison their arrows. *Strychnos toxifera* (Woorali, Urari, or Poison-plant of Guiana) is a native of Guiana, and was brought to this country by Sir R. Schomburgk. It had long been suspected that the poison used by the American Indians for their arrows was a species of Strychnos, but such was the secrecy with which they gathered the plant and prepared the poison that inquiries were frustrated. Sir R. Schomburgk's long stay in Guiana enabled him to decide the point; by bribing some of the natives, he induced them to guide him to a spot where their famous Urari flourished, and on arriving at the place, found it to be the species of Strychnos above described. In the preparation of the poison the juice of the bark is not the only ingredient, but forms about half of the bulk of the compounds used. *Strychnos pseudo-quina* (Quino do Campo) is a native of Brazil, and forms a scrubby plant about 12 feet high, with a corky bark. The fruit of this species is eaten by the natives. It yields copalche bark, which is said to be a valuable febrifuge.

STRYPE, JOHN, a laborious historian and antiquary, was born in London, 12th November, 1643. He studied at Cambridge, entered the church, and in 1670 was appointed vicar of Low Leyton, in Essex, where he resided for many years. He died at Hackney, 13th December, 1737. Although his works amount to thirteen large folio volumes, besides octavos and pamphlets, it was only in his forty-sixth year that he began with a single sermon; nor did he print anything more till five years afterwards. Then, in 1694, appeared, in a folio volume, his "Memorials of Cranmer." This was followed, in 1698, by the "Life of Sir Thomas Smith," secretary of state to Edward VI. and Elizabeth. In 1701 he published his "Historical Collections relating to the Life and Acts of Bishop Aylmer," and in 1705 his "Life of Sir John Cheke." In 1709 he brought out the first volume, in folio, of his "Annals of the Reformation and Establishment of Religion." Before proceeding further with this work he produced his "History of the Life and Acts of Archbishop Grindal," in 1710; his "Life and Acts of Archbishop Parker," in 1711; and his "Life and Acts of Archbishop Whitgift," in 1718. Then, digressing to another field of antiquarian investigation, he came forth, in 1720, with his new edition of Stow's "Survey of London," in two bulky folios, of which we may safely say that nearly three-fourths consist of his own additions. The next year, 1721, was published what may be regarded as his most important work, his "Ecclesiastical Memorials." But his labours were not yet closed; a second volume of his "Annals" appeared in 1725, a third in 1728, and a fourth in 1731. Strype claims the merit, and with considerable justice, of great fidelity and accuracy. His books, though somewhat prolix and dull, are all curious and valuable for the quantity of information they contain never before published, and not easily to be found elsewhere. A complete edition of his works was published by the Clarendon Press (1812–28), making twenty-seven volumes in all.

STUART FAMILY. The earliest member of this family whom we find on record is Alan Flahald, a Norman who accompanied William I. to England, and was rewarded

with the lands of Oswestry in Shropshire. His eldest son, William, remained in England, where he founded the family of the Fitz-Alans, earls of Arundel; the second, Walter Fitz-Alan, migrated into Scotland, and was appointed hereditary high-steward of that kingdom by David I. This title became the hereditary surname of his descendants, who modified it into Steuart, or the French form *Stuart*, which is now the best known. Walter, the first high-steward, was succeeded by his son Alan, and he by his son Walter; this second Walter by his son Alexander, who was one of the regents appointed during the minority of Alexander III., and who, in 1263, commanded the Scottish army at the battle of Largs. Alexander was succeeded by his son James, who died in 1309; and he by his son Walter, the comrade of Robert Bruce, whose daughter Marjory he married. Walter the Steward thus became the father of Robert the Steward, long regent of Scotland, who succeeded to the throne on the death of his mother's brother, David II., and took the title of Robert II. The list of kings of Scotland of this family, from Robert II. of Scotland to James VI. of Scotland and I. of England, is given in the article SCOTLAND. See also the articles JAMES I. and JAMES II.

The Acts of Settlement, passed in the reign of William III., secured the succession of the house of Hanover to the throne of England, and the descendants of James II. were subsequently excluded from the throne of Scotland also. The chief historical interest that attaches to the house of Stuart after the abdication of James II. is limited to the two invasions of Great Britain by his son and grandson, who are often respectively called the Old Pretender and the Young Pretender.

JAMES FRANCIS EDWARD STUART (the Old Pretender), was born on 10th June, 1688. His father, James II., died at St. Germains, in exile, on 16th September, 1701, and the prince was immediately acknowledged by Louis XIV. of France as king of Great Britain. In 1708 extraordinary preparations were made by Louis at Dunkirk with the object of invading Scotland. The Pretender embarked with the fleet. But the expedition was unsuccessful, partly from storms, which dispersed the French ships, partly from the vigilance of the English admiral, Sir George Byng, but chiefly from the dissensions of Fourbin and Gare, who had the command of the French fleet. The disappointed Pretender obtained permission of Louis to engage in the French campaign in Flanders. Upon the death of Queen Anne, who was favourably disposed towards her brother, and indeed is said to have been cognisant of his expedition to Scotland, Prince James, then residing at Bar-le-Duc, posted to Versailles, where, however, he met with an unfavourable reception from Louis XIV., and was informed that he must quit France. There seems some shadowy reason to believe that Prince James did really visit England in disguise shortly before the queen's death, though the famous description of such a visit given in Thackeray's masterpiece ("Esmond") is, of course, unhistorical. In August, 1714, James sent to the principal nobility of Great Britain a declaration asserting his claim to the throne. His friends were in the meantime not idle, and on 6th September, 1715, the Pretender's standard was set up by the Earl of Mar at Braemar.

A conspiracy was about the same time discovered in England. Treasonable designs were so widely spread in the western counties that at Bath the Jacobites talked openly of the Scotch rebellion as merely a diversion to draw the troops off to the north. The University of Oxford was also tainted with Jacobitism, and King James' health is reported to have been drunk there every day. The decisive measures of the government, however, promptly suppressed these manifestations.

In the north the next step of the insurgents was to proclaim James king at Newcastle-upon-Tyne, and to make an attempt on the town, which failed. The standard of "James VIII. of Scotland" was set up at Moffat in Annandale on 12th October by the Earl of Kenmure, who, being joined by a small detachment of English rebels, marched to Kelso.

In the meantime the Earl of Mar proceeded to Dunkeld, where the Marquis of Tullibardine and the Master of Sinclair joined his troops with 2000 men. They possessed themselves of Perth, and upon this important town being gained their force was much augmented. After various successes they attempted to reach Edinburgh, but the Duke of Argyle, the commander-in-chief of the king's forces in Scotland, sending a detachment to prevent their entrance into the capital, the rebels changed their course, and marched into Leith.

They proceeded southwards to Kelso, 27th October, where they were joined by the English and Scottish horse, under Mr. Forster and Lord Kenmure. But on the approach of General Carpenter from Newcastle the Pretender's forces marched to Jedburgh, and thence towards Dumfries. The Duke of Argyle was at Stirling with so small a force that unless he was soon joined by the Dutch or Irish troops, which were expected, he could not save Dumfries. Everything seemed to favour the enterprise of the Pretender, but divisions in the Jacobite council of war frustrated his plans. After some loss of time the rebels marched to Brampton in Cumberland, where the Pretender was proclaimed. They then proceeded to Penrith, and thence, on 5th November, to Appleby, next to Kendal, to Kirby Lonsdale, and on the 7th to Lancaster, which they entered without opposition. They left Lancaster on the 9th for Preston, where a crucial engagement was fought, and they were compelled to surrender on 13th November to Generals Carpenter and Willes. The number of the English and Scottish prisoners of all classes amounted to 1489. On the same day that Preston surrendered the battle of Dunblane or Sheriffmuir was fought between the Duke of Argyle and the Earl of Mar. The left wing of the rebels, though they fought bravely, was routed, and towards evening the duke drew off to Dunblane, and the enemy to Ardoch. On the same days news arrived that the Pass of Inverness was gained. This important advantage was the result of treachery. Lord Lovat had delivered it to the king's troops.

On 22nd December the Pretender landed at Peterhead in Scotland, with a train of six gentlemen, among whom was the Marquis of Tynemouth, son of the Duke of Berwick (natural son of James II.) He assumed the state of royalty, formed a court, made several peers, and created knights. In January, 1716, he made a progress through the country. But when the Duke of Argyle marched through Auchterarder to Tullibardine the Pretender and his followers hastily retreated to Dundee, and thence to Montrose, where they embarked on board a French ship then in the roads, and reached Gravelines in a few days.

The Earls of Wintoun, Kenmure, Derwentwater, Carnwath, and Nithsdale, with Lords Widdrington and Nairn, were tried at London. The prisoners of inferior rank were tried chiefly at Lancaster, where many were executed. One thousand of them, upon their petition, were transported to the plantations in North America. Derwentwater and Kenmure were beheaded on Tower Hill, 7th March. Lords Widdrington, Carnwath, and Nairn were reprieved. The Earls of Nithsdale and Wintoun escaped from prison. After the alliance of King George with France and the United States, Prince James was compelled to quit France and take refuge in Italy. In 1718 he became the instrument of Cardinal Alberoni's ambitious intrigues. He was advised by Pope Clement XI. to go into Spain, where a squadron had been for some time fitting out against England. Prince James was received with regal honours at Madrid; and the Duke of Ormond was appointed captain-

general of the expedition. But a storm dispersed and entirely disabled the Spanish fleet off Cape Finisterre; and a descent which the Spaniards made at Kintail in Scotland (June, 1719), although aided by the Highlanders, was defeated by General Wightman. During the year 1718-19 a marriage was agreed on between the Pretender and Maria Clementina Sobieski, granddaughter of John Sobieski, king of Poland. Two sons, Charles Edward and Henry, were the offspring of this union. Maria Clementina died in 1735.

In 1722 the Pretender published at Lucca his famous declaration, addressed to his loving subjects of Great Britain, and to all foreign princes and states, signed "James Rex." This document, which, among other articles, contained a proposal to George I. to resign his crown, was pronounced by the House of Lords a false, insolent, and traitorous libel, and was publicly burnt at the Royal Exchange.

James, during the latter years of his life, resided entirely at Rome, where he led a quiet life, although the hope of ascending the throne of England seems never wholly to have left him. The events of 1745 belong to the history of his eldest son, rather than to the annals of the Pretender's life. He was the last of the Stuarts that received kingly honours. He died at Rome, 1st January, 1766.

It raises a smile when the visitor to the crypt of St. Peter's reads the inscription on the plain unornamented stone sarcophagus of the exile.—"Jacobus III., Magnæ Brittanniæ, Scotiæ, Franciæ et Hyberniæ (for Hiberniæ) Rex; vixit annos 77, menses 6, dies 11; obyt (for obiit) kol (for kal) January (for Januarias), 1766."

CHARLES EDWARD STUART (the Young Pretender), born 31st December, 1720, bore the title of Prince of Wales among the Jacobites, and was created by his father Earl of Albany in 1734. He served in Spain under Don Carlos, who paid him great respect and attention. In 1743 Cardinal Tencin, the prime minister of France, combined with the Jacobites in England and Ireland to project a fresh invasion of Great Britain. He persuaded the Pretender to surrender his claims in favour of Charles Edward, and the prince set out for the coast of Picardy, where an army of 15,000 men was assembled, and transports were provided at Boulogne, Dunkirk, and Calais for carrying the troops to England. The army was to land on the coast of Kent; at the same time a squadron sailed from Brest to convoy the transports. But the squadron fled before the British fleet, under the command of Sir John Norris, a violent storm destroyed most of the transports, and a great part of the troops were drowned (1744). The prince returned to Paris to wait a more favourable opportunity, and the period at which the rebellion of 1745 was undertaken was favourable to its success. Towards the end of May, accompanied by a number of influential gentlemen, he left Paris for Nantes. On 5th July he embarked in a French vessel, which he had joined from Nantes in a fishing-boat, designed to sail round Ireland, and to land upon the western coast of Scotland. Another ship, the *Elizabeth*, was ordered to accompany him as a convoy, and on board this vessel the prince had placed £400,000 sterling, with arms for several thousand men. These two ships fell in with a British cruiser, a fierce action ensued, and the *Elizabeth* was so much damaged as to be obliged to put back into Brest. The prince pursued his course to Scotland, and landed, 28th July, at Barradale, on the shore of the bay of Lochnamuagh, Argyleshire. He went to the house of Kinlochmoidart, where he was met by several Highland chieftains, and whence the clans were summoned to rise. About ten days afterwards the prince set up his standard at Glenfinnan. On 27th August he advanced in hopes of meeting General Sir John Cope, the commander-in-chief in Scotland; but on reaching Garvamore he found that that commander had faced about, and taken the route by Ruthven to Inverness. It was now determined that the Jacobites should march to the south, and endeavour to get possession of Edinburgh before General Cope should arrive there. They reached Blair-Athol 30th August, and entered Perth 3rd September, where the Pretender's declarations were read. At Perth great numbers flocked to his standard. Among the most considerable were the Duke of Perth, Lord Strathallan, and Lord George Murray. The reception which the prince met with in the Lowlands was not so cordial as he expected. He arrived, 15th September, within 9 miles of Edinburgh, which (with the exception of the castle) capitulated two days afterwards. At noon, on the 17th, Charles, in a Highland dress, attended by the Duke of Perth and Lord Elcho, came by Duddingston into the King's Park, and entered Holyrood Palace. There was a great crowd assembled to receive him. "The figure and presence of Charles," observes Mr. Home, who witnessed his entrance to Holyrood, "were not ill-suited to his lofty pretensions. He was in the prime of youth, tall and handsome, and of a fair complexion."

In the meantime Sir John Cope had marched from Dunbar to Haddington, and thence to Prestonpans and Seaton. The Highlanders accordingly advanced to Tranent, 21st September, and continued their march until they saw the king's soldiers encamped near Preston. A morass, which was pronounced to be impassable, divided the armies. The afternoon was spent in manœuvring. At night both armies lay down to repose, the Highlanders with the resolution of attacking the king's troops early in the morning. During the night a country gentleman, who knew the ground well, offered to show the prince a part of the morass whence the rebels might attack their enemies without observation. Accordingly before break of day the morass was passed, and the two armies were separated only by a corn-field. The Highlanders followed up the advantage which they had gained with wonderful success. A panic seized the king's troops. The Highlanders threw down their muskets, drew their swords, and pursued the enemy. All the royal infantry were killed or taken prisoners, except about 170. This affray was called the Battle of Prestonpans.

Charles and his council did not deem it prudent to appear in England with so small an army, and resolved to wait some time longer at Edinburgh. The Castle of Edinburgh remained still in the possession of King George's troops, commanded by General Guest, between whom and the Highlanders a contest arose, during which several houses were set on fire, and several persons on both sides killed. Lord Kilmarnock and Arthur Elphinstone, afterwards Lord Balmerino, at this time joined the prince, and Lord Ogilvy, eldest son of the Earl of Airlie, arrived in the capital with a regiment of 600 men. Charles marched out of Edinburgh with about 6500 men, 31st October, in opposition to the advice of his council, leaving Lord Strathallan to command in Scotland. Carlisle surrendered to the Duke of Perth, 15th November. It was now determined to march directly to London. Leaving a garrison in Carlisle, the Jacobites pressed forward in two divisions; the first, commanded by Lord George Murray, arrived at Penrith, 21st November; the second, or main body, headed by Charles, chiefly composed of Highland regiments, followed, and advanced from Penrith, by Shap, Kendal, Lancaster, and Garstang, to Preston. On the 29th they reached Manchester, by way of Wigan, and were joined by 200 or 300 of the common people. Both divisions arrived by different routes at Derby, 4th December.

The royal forces, under the Duke of Cumberland, lay at Lichfield, Coventry, and Stafford. It seemed at first to be the intention of the prince to avoid the duke, and to advance to London; but after halting a day or two in Derby, he retreated, with the design of meeting some reinforcements coming from the north. The Duke of Cumberland now began the pursuit of the rebels, who were only two days' march before him. Lord George Murray, who commanded

the rear-guard, defeated the royal dragoons at Clifton, near Penrith. On 20th December the Scottish army left Carlisle, and crossed the Esk into Scotland. At Glasgow they remained seven or eight days, and then marched on Stirling. The town soon surrendered, and Charles' army, now amounting to 9000 men, attacked the castle. On 16th January, 1746, General Hawley left Edinburgh, which he had entered during Charles' absence, and marched to Falkirk, where he was totally defeated by the Highlanders, and lost his cannon and ammunition. The Duke of Cumberland arrived at Edinburgh, whither General Hawley had retired, 30th January, and on the following day he marched against the enemy. The rebels at first resolved to make a stand, and to give the duke battle; but on the following morning they raised the siege of Stirling Castle and retreated. During the months of February and March a desultory war was carried on, until, at the end of March, news was brought that the Duke of Cumberland was marching towards Inverness, which was occupied by Prince Charles. The prince retreated to Nairn, 14th April, where he again made a stand. That night the Highlanders slept amid the furze and trees of Culloden Wood, about 3 miles from Nairn. The prince's army was now much dispersed, and many of his best officers were absent. Nevertheless the prince and Lord George Murray, in opposition to the Duke of Perth and Lord John Drummond, who recommended waiting until the next day for reinforcements, resolved upon a night attack upon the Duke of Cumberland at Nairn. The duke, however, had gained intelligence of the attempt, and by five in the morning his army was on its march. The Highlanders, whose advance had been impeded by the darkness of the night, were weary and dispirited, and retraced their steps to Culloden, where many of them lay down to sleep. At eight o'clock the duke's forces were seen marching towards them; and about twelve they were within 2½ miles of the rebels. About one o'clock the battle began. The Highland regiments became impatient to attack, broke out from the line, and drove back the king's troops, sword in hand; but they were mostly brought to the ground by a terrible artillery fire. At this crisis the Duke of Cumberland advanced with the infantry, and the Highlanders fled.

The rebels are said to have lost about 1000 men. The prince, after dismissing the troops which followed him, went to Gorthleck, where Lord Lovat was, whence he sent a farewell message to the remnant of his army, thanking them for their services, but desiring them to attend to their own preservation. He next proceeded to Invergarie, near Fort Augustus, where he took leave of all his followers except Sullivan, O'Neil, and Burke, a servant who knew the country. Charles had now resolved to escape to France. Hunted from place to place, his adventures are scarcely equalled by the fictions of any romance. In this perilous condition Charles remained until the end of June, when he was delivered from his danger by Flora Macdonald, the daughter of Macdonald of Melton, in the isle of South Uist, who, at the risk of her own life, conveyed him to Skye as her maid, dressed in female attire. Here he was exposed to fresh perils, living in a cave for five weeks and three days; but at length, after many narrow escapes, he contrived to reach Morlaix, in Brittany, on 29th September. A very interesting account of this period of the prince's career is given in the "Autobiography of Flora Macdonald," edited by her granddaughter, published in 1869.

The prince was received in France with professions of affection by Louis XV., and he remained there until his departure became necessary to insure peace with England. He then repaired to Rome. Charles Edward married a princess of the house of Stolberg, in Germany. When the courts of Europe no longer gave him the title of Prince of Wales, he adopted that of Count of Albany, and sank into a lethargic habit of life strangely contrasted with his former activity. He died at Rome, 31st January, 1788. He had no issue by his wife; but he left a natural daughter, whom he created Duchess of Albany, and to whom he bequeathed a considerable property. His wife survived him, and married Alfieri, the dramatic poet.

The male line of the family terminated on the death of his brother, Henry Benedict, younger son of the Old Pretender, who was born at Rome in March, 1725. At an early age he was destined for the church, but the Pope granted him a dispensation by which he was enabled to hold ecclesiastical preferments without taking orders. In 1745, while his elder brother, Prince Charles, was in Scotland making a last effort to regain the throne of his fathers, Henry repaired to France, with the view of joining him at the head of some troops which were assembled at Dunkirk. But the news of the fatal battle of Culloden prevented their embarkation, and Henry returning to Rome, soon after took holy orders. In 1747 Pope Benedict XIV. raised him to the purple, with the title of Cardinal York; and he was subsequently created chancellor of St. Peter's and bishop of Ostia. On the death of Prince Charles in 1788, the cardinal caused medals to be struck, bearing his own portrait, with the inscription, *Henricus Nonus, Angliæ Rex;* and on the obverse, *Gratiâ Dei, non voluntate hominum.* This amiable but unfortunate scion of royalty was despoiled of his property, and reduced to a state of destitution by the French in 1798. His wants were generously relieved by George III., who bestowed on him a pension of £4000 a year. The cardinal died at Tusculum in 1807.

There does not now exist a lineal male representative of any of the crowned heads of this family, though the clan is still numerous in Scotland.

As the inscription upon the tomb of James III. in the crypt of St. Peter's was given above, those of his sons may also be added as being of interest. The Young Pretender's tomb bears the following. "D.O.M. Carolus Jacobi III. magnæ Brittanniæ Franc. et Hib. regis filius, natus 1720, obiit pridie Kal. Februar. 1788." That of Cardinal York is similar, "D.O.M. Henricus IX., Jacobi III. mag. Britt. Franc. et Hib. regis filius, Dux Eboracencis (Duke of York) nuncup. ep'us Ostien et Velitem. S.R.E. Vice cancellar.; S. Coll. Decanus, SS. Basilicæ Vatican. Archipr. (Nuncio, Bishop of Ostia and Velite, Vice Chancellor, Dean of the Sacred College of Cardinals, Archpriest of the Vatican Basilica). Tusculi obiit, 13th Jul., 1807; vixit annos 82, menses 4, dies 7.

We may briefly allude to the minor branches of the Stuart family. The dukedom of Albany and earldom of Mar was bestowed on Alexander, second son of James II. of Scotland. It became extinct in 1536. The dukedom of Albany and earldom of Fife, bestowed on Robert second son of Robert II., were forfeited to the crown in the reign of James I. The earldom of Castlestuart dates from 1800; the viscounty from 1793; and the barony from 1619. The earldom of Angus was conferred on George, natural son of William, first earl of Douglas, in 1389. The earldom of Darnley in the Stuart line became extinct in 1672. The Blantyre family was first created in 1606. Lastly, the Marquis of Bute is a Stuart. Sir James Stuart, descended from a natural son of Robert II., was raised to the peerage as Earl of Bute in Queen Anne's reign; and the fourth earl was advanced to the marquisate.

STUART, ARABELLA, or ARBELLA, was born, according to various statements, in 1575, 1576, or 1577. She was the only child of Charles Stuart, duke of Lennox, younger brother of Henry, Lord Darnley, the father of James I. of England and VI. of Scotland. James and she therefore were full cousins. The Lady Arabella also stood in the same degree of relationship to Elizabeth that James himself did through his mother; both were great-grandchildren of Henry VIII.'s eldest sister Margaret; James through his mother, Queen Mary, and her father,

James V. of Scotland, son of that princess by her first husband; Arabella by her father, Charles Stuart, and his mother, Margaret Douglas, the daughter of the English princess by her second husband, Archibald Douglas, earl of Angus. Arabella was born in England, and during the reign of Elizabeth that circumstance was openly stated by Parsons the Jesuit (in his "Conference about the next Succession to the Crown," published under the name of Dolman, in 1594), as giving her claim to the throne an advantage over that of the Scottish king. At all events she was undoubtedly, before the birth of his son Henry in February, 1594, the next in order of succession to James; and if he had died without issue, she would have been Elizabeth's heir, upon the same principle that he was so accounted.

She first became an object of general public attention by the manner in which her name was brought forward in 1603, after the accession of James, in the alleged plot of "the Main," for which Sir Walter Raleigh was tried. One of the charges against him was, that he designed to raise the Lady Arabella to the throne, under the protection of Spain. There is no probability, however, that any such design was ever entertained. But her situation was difficult and dangerous. It was the king's wish that she should remain unmarried; but in February, 1609, a discovery was made of a love affair in which she was engaged with William Seymour, second son of Lord Beauchamp, the eldest son of the Earl of Hertford; and although both parties were called before the council and sharply reprimanded, they contrived to effect soon afterwards a secret marriage. It was discovered in 1610, and Seymour and the lady placed in separate confinement. Arabella, however, contrived to escape from Highgate, where, on pretence of illness, she had remained in custody; and Seymour from the Tower. Disguised in male apparel, the lady, on 3rd June, 1611, at six o'clock in the morning, reached Blackwall, where, going into a boat that was in readiness, she was rowed down the river, and next morning was taken on board a French vessel that waited for her and her husband at Leigh. But as Seymour did not make his appearance so soon as had been agreed upon, the vessel set sail without him, and he was obliged to make a bargain with a coaster from Newcastle to take him across to Flanders, which he reached in safety. His wife was not so fortunate; a small ship of war was despatched from the Downs to intercept her, and she was captured in Calais Roads. She and Seymour never again met. She was thrown into the Tower, where she died insane, 27th September, 1615.

STUART, JAMES, frequently called *Athenian Stuart*, was born in London, in 1713, of humble parents. In 1742 he set out for Italy to improve his knowledge of art. After residing at Rome nearly seven years, he embraced the offer made to him by his friend Revett, of joining him in an excursion to Greece. Having previously issued a prospectus of their undertaking, and raised funds for their tour, by subscriptions received from England, the travellers quitted Rome in March, 1750. They passed some time at Venice, and in March, 1751, reached Athens, where they remained till about the end of 1753. They returned to England in 1755, but it was not until 1762 that the first volume of the "Antiquities" was published. Stuart appears to have had by far the greater share in the labour, and the literary part is ascribed entirely to him. He did not, however, prosecute his work very diligently, for the second volume was not entirely completed, and the third only in progress, at the time of his death. Neither was he very eager to avail himself of the opportunities afforded him as a practising architect. Lord Anson bestowed on him the appointment of surveyor of Greenwich Hospital, which placed him in easy circumstances, and he willingly relaxed from continued exertion. His principal work is the chapel of Greenwich Hospital, as rebuilt by him, after being destroyed by fire. He died 2nd February, 1788. The second volume of the "Antiquities" was edited by Newton, 1790; and the third by Reveley, in 1704.

STUC'CO, an Italian word adopted in most other languages, and applied as a general term to plaster of any kind used as a coating for walls. It was very much employed by the ancients, and not merely for coating columns, &c., constructed of brick, but in many instances for covering stone, or even marble; for which last purpose it was applied so sparingly as to be no more than a very thin incrustation, for the purpose, it is now supposed, of being painted upon. The name is sometimes, though incorrectly, applied to all descriptions of lime or cement renderings on masonry, whether external or internal, but is really given by builders to a species of plastering, in ordinary cases worked up by hand to a fine face adapted to receive paint; or in superior buildings, made by the addition of other materials than the lime or plaster usually employed, in order to resemble marble. Common stucco, in fact, is nothing more than plastering which has received an additional amount of manipulation; marble stucco is made with fine lime (composed of the pure hydrate of that base) mixed with calcareous powder, chalk, or other analogous substances, in such proportions and worked in such manner as to produce a hard uniform surface, which admits of being coloured, painted, and polished, so as to represent valuable marbles. It is employed in decorative architecture to cover columns, pilasters, walls, cornices, plinths, &c., in sheltered or covered positions; in external works, the natural or the artificial calcareous cements, as well as those of an oleaginous nature, are used for this purpose—a distinction unknown to the Italians, the first adopters of *stucco tura*, from whom we have derived the art, and the name, of the fine plastering used by us exclusively for decorative and internal works.

When perfectly well executed, stucco is nearly equal in appearance to stone, and even superior to stone of an inferior quality. There are some who protest against its use externally as a spurious and meretricious mode of building with sham material; but it is certain that most of Palladio's edifices, and of what are spoken of as the "marble palaces" of Venice and Rome, are merely faced with stucco.

STUHLWEIS'SENBURG, a town of West Hungary, capital of a county of the same name, in a marshy tract, 16 miles north-east of Lake Balatony, on the railway from Buda to Trieste. It has some handsome buildings, including the cathedral, bishop's palace and offices, county hall, the Marienkirche, in which fourteen kings of Hungary are buried; a gymnasium, Roman Catholic schools, a military academy, Magyar Theatre, manufactures of knives, soap, cloth, flannels, and leather, a trade in wine, and large cattle markets. A great quantity of soda is extracted from the swamps, which also abound in fish, crabs, tortoise, and water-fowl. The population of the town is about 14,000. Stuhlweissenburg is built on the site of the Roman *Floriana*, and from 1027 to 1527 was the residence of the sovereigns of Hungary. In late times it has suffered much from the ravages of war, and was for some years in the hands of the Turks.

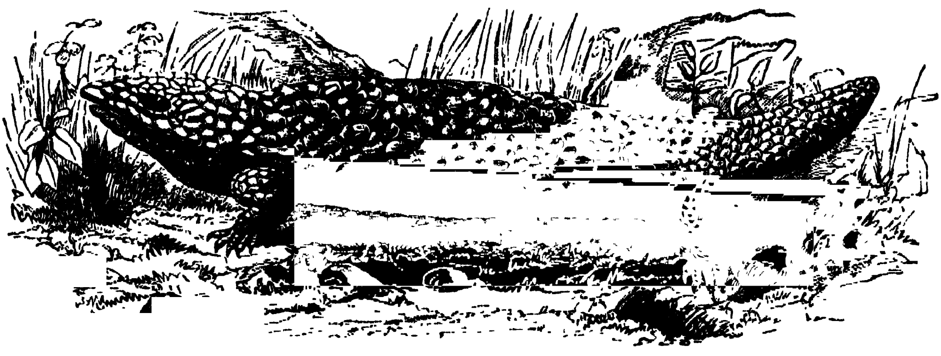
STUMP, a light roll of paper sharpened to a point like a pencil, and used by artists to rub down lines in charcoal and crayon drawing, so as to produce a soft even ground tint, a graduated tone, &c. The use of the stump easily degenerates into abuse, and it readily becomes fatal to definition of drawing if it is not most carefully employed. Its characteristic smooth prettiness of effect rendered it a favourite drawing implement in the last generation, whose taste this exactly suited; but the stump is now rarely seen except in the hands of technical artists.

STUMPHA'LIS, BIRDS OF. These creatures of the Greek mythology inhabited the Lake of Stumphalis, in

the north-east of Arcadia. They were carnivorous birds, especially delighting in human flesh. Their beaks and talons were of brass, their feathers had brazen-pointed shafts as sharp as arrow heads, and they were able to shoot them. It was one of the labours of Hêraklês to destroy these birds, which had multiplied in such numbers as to become a serious danger to the land, since no man's life was safe in their proximity. He loudly sprang a brazen rattle, given him by Athêna, to attract them, and slew them by crowds with his arrows as they thronged towards the noise; the rest were so frightened that they flew away to an island. Here they were encountered afterwards by the Argonauts, who suffered much from their falling feathers, and who got rid of them by raising a deafening clamour which frightened them.

There seems no doubt but that these birds typified the biting cold snowstorms of winter. We observe, too, the very early belief that noise scared away evil things, a belief largely colouring the practices of the middle ages. To this day the Chinese, as well as many other Oriental nations, keep up an incessant din with drums and metal plates, &c., during an eclipse, to frighten off the invisible dragon who is eating up the sun; and the Roman Catholic service books prescribe a bell as part of the machinery for the exorcism of demons (bell, book, and candle).

STUMP-TAIL (*Trachydosaurus rugosus*) is a remarkable LIZARD belonging to the family Scincidæ, common in Western Australia. The tail is blunt, and bears an extraordinary resemblance to the head; so that when this lizard remains motionless, with closed eyes, it is difficult to distinguish head from tail. It has a thick spindle-shaped body, and four short limbs. The upper part of the body is covered with large, thick, rough, convex scales, and the under surface with smaller scales.



Rough Stump-tail (*Trachydosaurus rugosus*).

It is of a pale yellow colour, with broad, rather irregular, yellow cross bands. The stump-tail frequents open sandy plains. It is of sluggish habits, whence the name Sleeping Lizard frequently given to it.

STUR'GEON (Acipenseridæ) is a family of fishes belonging to the order GANOIDEI. The sturgeons have an elongated fusiform body, protected by five longitudinal rows of bony plates or bucklers. The head is covered with bony plates, and terminates in a long pointed snout; the small mouth is placed on the under surface of the snout, and is tubular, protrusible, and without teeth; in front of the mouth are four barbels, which act as organs of touch. The tail is markedly heterocercal or unsymmetrical, the vertebral column being prolonged into the upper lobe, and strengthened by fulcra along its upper margin. The dorsal and anal fins are small, and placed near the tail. There are four true gills and two accessory gills. The gills are free, and are protected by a large bony gill-cover or operculum. There are no branchiostegal rays. The air-bladder is large, and communicates with the œsophagus by a duct. The skeleton is mainly cartilaginous, and the vertebral column is represented by the persisting notochord, which has a sheath of cartilage. The skull is, however, covered by bony plates, which are ossifications of the skin (or membrane bones), and bones of the same character take part in the formation of the fin-girdles.

The sturgeons are large fishes, confined to the temperate regions of the northern hemisphere. They either inhabit fresh waters altogether or ascend rivers from the sea in spring for the purpose of spawning. They feed on the soft decaying substances, animal and vegetable, which they stir up from the bottom with their snouts, and also on small fishes. They are oviparous, the eggs being very small and numerous. The flesh is white and firm, and resembles veal in flavour; it is eaten both fresh and salted and pickled. In addition, sturgeons furnish two important articles of commerce, CAVIARE and ISINGLASS, the first of which is prepared from the roe of the female, and the latter from the inner coats of the air-bladder.

The Common Sturgeon (*Acipenser sturio*) is found in the Mediterranean, Black, and Caspian Seas, and the rivers opening into them, on the coasts and rivers of northern Europe, including Britain, and on the east coast of North America. It is not uncommon in the mouths of British rivers. Formerly, when taken in the Thames, within the lord mayor's jurisdiction, it was regarded as a royal fish, and reserved for the sovereign's table. It is generally from 6 to 10 feet long, but sometimes attains a length of 18 feet. The flesh is delicate, and is largely consumed in Russia. The Beluga or Hausen (*Acipenser huso*) occurs in the Black Sea and the Sea of Azov, and the rivers that flow into them; it is also found, though rarely, in the Mediterranean. It is a large species, generally from 12 to 15 feet in length, and weighing 1200 pounds; it is occasionally much larger. The STERLET (*Acipenser ruthenus*), common in Russian rivers, is a much smaller species, 2 or 3 feet long. One species, *Acipenser sinensis*, is confined to China, where it is reserved for the emperor's table. Several species are found in North America, south of lat. 54° N., furnishing food to the native Indians, and being taken for the market. See Plate GANOIDEI, vol. vi.

There is a second genus of the family Acipenseridæ, Scaphirhynchus, distinguished by having no spiracles, by the posterior part of the tail being entirely enveloped by bony plates, and by its shovel-like snout. There are four species, all confined to fresh waters; one in the Mississippi, and the other three in the rivers of Central Asia.

The PADDLE-FISHES (Polyodontidæ) are nearly allied to the sturgeons, differing chiefly in their naked body, and the presence of minute teeth in the jaws.

STUR'LESON, SNORRO. See SNORRO.

STUR'NIDÆ. See STARLING.

STUTT'GART, the capital of Würtemberg, South Germany, is beautifully situated 2 miles from the left bank of the Neckar, and in 1881 had 117,303 inhabitants, nearly all Protestants. In 1855 the population was only 51,000. The town, built in the valley of the Nesenbach, is entered by an avenue of poplars, and surrounded on three sides by hills covered with vineyards and gardens, which may be seen from all the streets, and in summer give a rich and beautiful appearance to the environs. The old part of the city, which is now, however, but a very small portion, is ill built, the streets being narrow and irregular, and the houses for the most part of wood. The more modern parts have straight and broad streets, intersecting each other at right angles, and containing many handsome buildings. In fact, taking it on the whole, Stuttgart is one of the handsomest towns in Germany. The best street is the Königs Strasse, which crosses the whole city, passing one end of the square in which the old and new palace and the theatre are situated. The new palace, or Schloss, is a noble edifice, consisting of a centre and two wings; it has an extensive park, and in front of it is a spacious parade. Its gardens and grounds are very fine, and extend for 2 miles to the new royal country seat of Rosenstein, near Kannstadt. Altogether they have an area of 560 acres, and are most tastefully laid out. They are freely open for promenades to all classes. The palace contains a good collection of paintings and statues (many of them by Dannecker and Canova), and the windows command delightful views over the adjacent country. In the vicinity of this building there are several public institutions. Among others deserving notice are—the Gymnasium Illustre, the former military academy, which resembles a palace; the old palace, now occupied by the officers of the government; the opera-house, royal mews, containing accommodation for 300 horses; riding-school, and stud-house, parliament house, mint, museum of natural history, with a remarkable series of fossils, found near Kannstadt; an English church, hospital, and three barracks, which are among the most considerable buildings in the city. Behind the old palace is the Stiftskirche, which contains the monuments of the dukes of Würtemberg from the thirteenth to the seventeenth century. In front of the Stiftskirche is a colossal bronze statue of Schiller, designed by Thorwaldsen; and the town also contains a statue in honour of Blücher. The Public Royal Library contains 300,000 volumes, and is chiefly distinguished for its collection of Bibles, consisting of more than 8000, in sixty different languages. The King's Library, of 50,000 volumes, contains valuable old works and manuscripts, besides a great variety of modern publications. There are also many private libraries. Stuttgart has a gymnasium, an academy and school of arts, botanic garden, a veterinary school, savings bank, and numerous useful and charitable institutions. The royal villa of Rosenstein is built on a projection between two valleys, and commands fine views of the capital, the valley of the Neckar, and the town of Kannstadt (resorted to by the citizens of Stuttgart as a watering-place) on the right of that river. There are manufactories of linen and woollen cloths, silk, cotton, gloves, carpets, shawls, perfumery, &c. Stuttgart is noted for its beautiful works in gold, silver, iron, tin, and bronze; mathematical, philosophical, optical, and musical instruments; cabinet furniture, lacquered ware, and carriages. It also contains some breweries and vinegar works, and upwards of thirty printing establishments. It is, moreover, the place of meeting for the Booksellers' Union of Southern Germany. The navigation of the Neckar gives it water communication with the Rhine, and lines of railway connect it with the principal cities in Germany, France, Belgium, Holland, and Switzerland.

STYE (Lat. *hordeolum*, from *hordeum*, barley) is the name given to a boil which appears on the edge of the eyelid. It has its seat in the cellular tissue at the margin of the lid, involving generally the roots of one or more of the eyelashes. Styes are most common in young people, especially in such as are troubled with poorness of blood, and they often have derangement of the digestive organs for an exciting cause. Where they occur repeatedly attention must be paid to the general health, as in addition to the pain and inconvenience to which they give rise they may cause permanent disfigurement from the destruction of the hair bulbs on the margin of the eyelid. An individual stye is best treated by warm and emollient fomentations until it matures, when relief, followed by speedy healing, results from the discharge of the pus. Should the discharge be delayed the yellow spot may be opened with a needle or the point of a sharp lancet, which will immediately relieve the pain and probably cause a speedy subsidence of the swelling.

STYLE. See STIGMA.

STYLE, an ancient writing implement. See STILUS.

STYLE, OLD AND NEW, in chronology. See CALENDAR.

STYLES OF ARCHITECTURE. The principal are described under the heads of EGYPTIAN, GREEK, and ROMAN ARCHITECTURE; ROMANESQUE, GOTHIC, ITALIAN, MOORISH, RENAISSANCE, and CHINESE ARCHITECTURE respectively. A separate article deals with the various styles of ENGLISH CATHEDRAL ARCHITECTURE.

STYLIDI'EÆ is an order of plants belonging to the group GAMOPETALÆ and cohort Campanales. There are about 100 species, nearly all natives of Australia, a few being found in New Zealand, tropical Asia, and South America. The species are herbs or undershrubs, with simple entire leaves without stipules, and irregular flowers in a raceme or corymb. The calyx is two-lipped, the upper lip three-lobed, the lower two-lobed; the corolla is gamopetalous, with an irregular five-lobed limb and a short tube. The stamens are two, with the filaments united with the style into a column, which is often irritable, and the anthers sessile on the top of the column. The ovary is inferior, two-celled, with the stigma often hidden by the anthers. The fruit is a two-celled capsule, with numerous albuminous seeds. Only four genera are included in this small order, the majority of the species belonging to the typical genus STYLIDIUM.

STYLID'IUM is a genus of plants belonging to the order STYLIDIEÆ. This genus contains over eighty species, all, with two exceptions, confined to Australia. They are herbs or small shrubs, with scattered entire leaves, and pink, white, or violet irregular flowers. The flower is remarkable for exhibiting irritability in relation to insect-fertilization. One of the lobes of the corolla (*labellum*) is smaller than the rest, and depressed. The stamens are united with the style into a column, longer than the limb of the corolla, the stigmatic surface lying in a cavity at the apex of the column, surrounded and hidden by the anthers. This column is highly irritable; it hangs down over the labellum, becoming most sensitive at the moment when the anthers burst; at the slightest touch it then springs up, straightens itself, and bends over to the other side. The stigma matures after the anthers have shed their pollen.

STYLI'TES (Gr. *stuleitês*, from *stulos*, a pillar), the name given to a class of hermits who, in the early ages of Christianity, mortified the flesh by living on the summit of a pillar. The most famous are St. Simeon of Antioch and his successor, St. Daniel of Constantinople.

Simeon was born in 390, probably at Antioch, thirty-six years after the death of the first hermit, St. Antony. Led by the example of Antony, and perhaps prompted on the score of vanity through beholding his enormous influ-

ence, crowds of Oriental Christians adopted the life of the anchoret. In the desert, to the south of Alexandria alone, 5000 were counted at the time of Simeon's birth. In one island of the Nile alone, near Thebes, Pachômios was superior of 1400 monks; and he founded ten other monasteries, and not unfrequently at Easter-tide he welcomed 50,000 who acknowledged his rules of discipline. In the city of Oxurinchos lived 10,000 monks and 20,000 nuns. Altogether when Simeon was a boy, it was asserted by the Egyptians themselves that there were as many monks as laymen; and allowing for gross exaggeration, it is evident that a vast national movement overwhelmed the country. Ordinary asceticism was soon at a discount; to gain a reputation for special sanctity penances of a horribly cruel nature were necessary to be undergone. Hermits scattered themselves along the wastes of the inhospitable Euxine, and the great Basil himself lived such a life for ten years, between the sea and the putrid marshes. Not content with these austerities men loaded themselves with crosses and chains, and lived in holes and caves, while some went naked, the more nearly to approach the existence of a brute. To live many days without food or without sleep, or to pass years without speech—these things were worthy striving after, and were held an acceptable sacrifice to God.

When the young shepherd of Antioch left his flocks at thirteen to join the Syrian hermits, it was among such fanaticism that he found himself. He was repeatedly at the point of death from voluntary starvation and exposure, living apparently for the purpose of outdoing his brother sufferers. About the year 427 Simeon hit upon an entirely new penance, new at all events to Western Asia—perhaps Indian fanaticism had already used such austerities. He had retired to a mountain about 30 miles to the east of Antioch in 424, and had passed three years chained by the right leg in a narrow *mandra* or circle of stones. Here he now built a pillar 9 feet high, upon which he lived for three more years, engaged in constant prayer and quite unprotected from the weather. He then descended from this while another was built twice as high, and of much less diameter, which formed his home for another three years. In 433 he had a third pillar built, 30 feet high and still narrower; and finally, in 439, a fourth, 60 feet high, and, according to one account, only 3 feet in circumference at the top, but this is undoubtedly false. There is no doubt that the hermit had scarcely more than standing room, and long practice had enabled him to balance himself when others must have fallen. He never descended from this fourth pillar, where he spent no less than twenty years. He died 459, in his seventieth year. Tennyson has a magnificent poem on this extraordinary devotee, and thus enumerates his stages of sanctity:—

> "Then, that I might be more alone with Thee,
> Three years I lived upon a pillar, high
> Six cubits; and three years on one of twelve;
> And twice three years I crouched on one that rose
> Twenty by measure; last of all, I grew
> Twice ten long weary years to this
> That numbers forty cubits from the soil"

Crowds came from the east and the west, from India and from Gaul, to visit the self-martyr on his pillar Miracles were performed. Simeon became an oracle, and his wanderings in his frequent trances were noted as inspired revelations. The Emperor Theodosios habitually consulted him in state and church difficulties; the queens of Arabia and Persia gratefully acknowledged his aid; armed Saracens forced their way to him to obtain his blessing. He often prayed with arms outstretched in the figure of a cross for incredibly long times together; and another practice was to bow till his forehead touched his feet (so say the contemporary accounts) for great numbers of times. A witness has left it on record that he had repeated his bowings 1244 times on one occasion, and was still continuing when the observer lost count. At last Daniel, a disciple, observed him motionless for three days, his iron collar on his neck, his solitary goatskin garment blowing to and fro in the wind. He climbed the pillar, and smelt a wondrous odour of spices and perfumes—the saint was dead. Antioch claimed his remains, which six bishops and as many thousand soldiers escorted to the tomb, the Emperor Leo in vain craving the holy body as a relic.

St. Daniel forthwith had his own pillar erected near Constantinople, and lived upon it thirty-three years, dying in 494. He was several times blown off his pillar by the storms of Thrace, but his life was miraculously preserved, and he worked out his long task.

STY'LOBATE. In its general meaning this term signifies any basement upon which columns are raised above the level of the ground or floor; but in its technical sense it is applied only to a continuous unbroken pedestal, upon which an entire range of columns stand—in contradistinction to *pedestal*, the basement of a single column.

STYLOP'IDÆ is a remarkable family of BEETLES (Coleoptera), now placed in the section HETEROMERA, near the Blister-beetles (Cantharidæ) and Oil beetles (Meloidæ). Formerly this group was considered a distinct order, to which the name Strepsiptera was given. These insects are extremely minute, and the young and adult females are parasitic on the bodies of other insects, chiefly bees and wasps. The females are without legs, wings, or eyes, and resemble larvæ. They are embedded in the abdomen of their host, only the head and the anterior part of the thorax emerging. The males, on the other hand, are winged and active. Their hind wings are very large and membranous, but the wing-covers or elytra are reduced to two slender appendages. The head is very short and broad, with large prominent eyes, and curiously forked antennæ. The thorax is large in proportion to the small slender abdomen, and the prothorax is very short, and closely connected with the mesothorax. As the males live only a few hours, and take no food, the mouth organs are in a very rudimentary state. The tarsi have two or four joints, and have no claws. The largest of these insects does not exceed a quarter of an inch in length, and some are very minute.

The life-history of these insects is as remarkable as their structure. The females are viviparous, the larvæ crawling out of the exserted portion of the parent's body on to the bee's abdomen. The larvæ are in this stage provided with six feet, and with jaws, and are tolerably active. They are carried attached to the hairs of bees into the nests, where they make their way into the soft bodies of the grubs, and feed on their substance, losing after a time their feet and eyes. They continue to live in this way within the body of their host without hindering its growth into an adult bee, till at length they protrude the anterior part of their bodies between the segments of the bee's abdomen. The male escapes at this stage, and acquires wings; but the female remains, living and dying a parasite. The species are tolerably numerous, and eight are found in Britain. Most of the species are parasitic on bees and wasps, but some infest ants and other insects.

Figs. 35-38, Plate III. BEETLES, prefixed to the second volume of this work, are illustrative of this remarkable family.

STYMPHA'LIAN BIRDS. See STUMPHALIS.

STYP'TICS, in medicine, are such substances as are used locally to arrest the discharge of blood. Some of these, like matico, tannin, or cobweb, encourage the coagulation of blood by supplying a rough material round which fibrin may be deposited; others are used as astringents, and seem to act by causing the minute bleeding vessels to shrink together. Of the latter class galls in powder, alum (especially burnt), and acetate of lead are good examples. Cold is one of the best and simplest styptics, especially when it is applied in the form of ice. Perchloride of iron

is also a powerful styptic, but one of the most powerful of all is solid nitrate of silver, applied so as to touch the bleeding surface. Where a large vessel is severed styptics are unavailing, and recourse must be had to bandaging, the tourniquet, or the surgical operations of tying, twisting, or otherwise securing the injured part.

STYRA'CEÆ is an order of plants belonging to the group GAMOPETALÆ and cohort Ebenales. There are about 220 species, chiefly natives of tropical Asia and America, a few being found in North America. They are shrubs or small trees, with alternate simple leaves without stipules, and axillary flowers, often white, solitary, or in racemes. The calyx is free, with four or five teeth. The corolla is four or five-lobed, the lobes being almost free, scarcely cohering at the base. The stamens are inserted at the base of the corolla, sometimes eight to ten, sometimes numerous. The ovary is inferior, or more or less superior, two to five celled, with a simple style. The fruit is a one-celled drupe or berry.

This order is chiefly remarkable, in an economical point of view, for furnishing the gum-resins STORAX and BENZOIN of commerce. Some of the species of Symplocos are used for dyeing yellow, and *Symplocos Alstonia* is employed as a substitute for tea in South America. The various kinds of Halesia are the Snow-drop Trees of Carolina.

STYR'ACIN, or Styrylic Cinnamate, is obtained from liquid storax, *Styrax officinalis*, natural order Styraceæ. It crystallizes in prisms, having the formula $C_{18}H_{16}O_2$. It is insoluble in water, slightly soluble in alcohol, very soluble in ether. It melts at 44° C. (111° Fahr.), and distils without decomposition at 180° C. (356° Fahr.)

STYR'IA, a crownland of Austria, bounded N. by Upper and Lower Austria, W. by Illyria, S. by Illyria and Croatia, and E. by Hungary. The area is 8669 square miles, and the population in 1880 amounted to 1,213,597, mainly of German descent, and nearly all Catholics. The northern and western part of the country is covered with high mountains, which are called the Styrian Alps. Properly speaking, they are branches of the Julian Alps, which extend to the east. One of them separates the valley of the Ens from that of the Mur, runs south-east as far as the Wild Alps to the west of Semmering, where it joins the Noric Alps, and then, proceeding in a south-easterly direction, gradually declines to the plain of Oedenburg. The other branch divides the valley of the Mur from that of the Drave, and forms the frontier between Styria and Carinthia. A third mountain chain runs from Loibl to the Save, and forms on that side the boundary towards Carinthia. All the hills afford good pasture, and are covered in many places with fine forests. The mountaineers, like the Tyrolese, are excellent marksmen and intrepid hunters. The highest summits are the Grössenberg, 8381 feet; the Eisenhut, 7676 feet; the Grimmin 7540 feet; the Stangalpe, 7140 feet; the Hochschwab, 7154 feet; and the Bachstein, 7008 feet above the sea. The southern and eastern parts of the province contain few lofty mountains. The country has numerous rivers, all of which flow into the Danube. The principal are—the Mur, which rises in a lake, traverses the centre of the country for about 180 miles, is joined by many smaller rivers, and entering Hungary below Luttenberg, soon after flows into the Drave; the Drave, which enters Styria 58 miles east of Villach, passes Marburg, and from a few miles above Warasdin runs along the Croatian and Hungarian frontiers; the Ens, the Raab, and the Save, which forms part of the southern boundary. The Mur, Drave, Ens, and Save are navigable by boats. There are many small lakes. The country abounds in cold, warm, and hot mineral springs, the best known being those of Rohitsch, Neuhaus, and Sekau. Styria has numerous caverns, the most interesting of which is that of Mirnitz.

The air in the mountainous part is cold, in the valleys of the south the temperature is much milder. The wolf and bear are still found in the forests. The common domestic animals, with game, poultry, fish, and bees abound. The breeding of cattle, which are small, is very general. Sheep are not numerous, and the horses are more fit for draught than for the saddle. Four-fifths of the land is under cultivation, and very good crops are produced. Wheat, rye, barley, and oats are grown in the north-west; in addition to these the products in the south-east include maize, millet, buckwheat, oleaginous seeds, tobacco, some flax and hemp, hops, pulse, and vegetables of various kinds. Wine and fruit are also among the chief productions. Timber is a very important article of commerce. The principal kinds are oak and beech; but pine, fir, chestnut, walnut-tree, red yew, lime, white poplar, and willow are scattered over the whole country. The great wealth of Styria, however, consists in its mines, which are confined to the mountainous portion of the country. The principal minerals are—gold, silver, copper, lead, zinc, iron, alum, cobalt, sulphur, salt, marble, and coal.

The most important manufactures are of iron and steel. The iron mines in the Erzberg, in the north, were well known to the Romans, and have been worked without interruption for eleven centuries. There are also some manufactories of brass and lead articles, earthenware, paper, tobacco, white lead, vitriol, linen, cotton, woollens, and silk, but none of considerable importance. There is a very brisk trade between the north-west and south-east of Styria; the latter supplies the former with corn, wine, and tobacco, and receives in return iron, timber, and salt. The exports consist of the metals above named, and of scythes, sickles, steel and iron wares, including razors, and several millions of Jew's harps. The imports consist of fine cloths, linens, cottons, silks, and jewelry, and colonial produce. The transit trade between Italy and Germany, from Vienna to Trieste, is very important. It is greatly facilitated by good common roads, and by the Vienna-Trieste Railway, which crosses the Styrian Alps, at the Semmering Mountain, by many curves, bridges, and tunnels, attaining the height of nearly 3000 feet above the sea.

The establishments for education are the University of Gratz, two theological schools, four gymnasia, and about 1000 common schools. The hospitals, infirmaries, and other charitable institutions are very numerous.

Gratz, the capital of Styria, is on the Mur, in 47° 4′ N. lat., 15° 26′ E. lon., 90 miles S.S.W. from Vienna, and has 70,000 inhabitants. It consists of the Inner Town (which lies between the left bank of the Mur and the Schlossberg) and five suburbs. The situation of the city is beautiful in the extreme. In the plain surrounding it the Mur flows through fields of corn and picturesque rural hamlets, while at a short distance rises an amphitheatre of hills, none very high, but finely diversified in form, green, and wooded; and beyond these again are beheld, towards the north and west, the lofty mountain masses of Upper Styria and Carinthia, rising in rugged grandeur, and for the greater portion of the year covered with snow. The whole circuit of Gratz is about 7 miles. The Inner Town, which is built in the old style, with narrow irregular streets, is surrounded by high ramparts and a glacis, which is planted, and forms an agreeable public walk; the defences were greatly strengthened in 1849–50. It is entered by six gates, and contains several good buildings, the principal of which are—the cathedral, a Gothic structure, built by the Emperor Frederick IV. in the middle of the fifteenth century, with all the altars finely sculptured in marble; and near it St. Catherine's chapel, the handsomest specimen of architecture in the town, containing the tomb of the infamous Ferdinand II., who was a native of this place; the Imperial Burg, with its tower, opposite the cathedral, where the princes of Styria formerly resided; the Landhaus, where the nobility held their sittings; the town-hall;

the university buildings, containing a library of upwards of 100,000 volumes, a collection of philosophical instruments, &c.; the Convict, the largest building in Gratz, formerly a Jesuit college, and now a public school; an arsenal, a theatre, several palaces of the Styrian nobility, &c. On the Schlossberg (a mass of limestone 300 feet high), on the east side of the town, were, not long since, the ruins of a strong castle destroyed by the French in 1809, and from which the town originally derived its name. The Murstadt, which is on the right bank of the river, and connected with the Inner Town by two bridges, is the finest and most extensive of the suburbs of Gratz, being embellished with several notable buildings, squares, and gardens. The Jakomini suburb has handsome and regular streets, a riding house, &c.; and the Leonhardt, to the north of the Schlossberg, occupies a large space of ground at the foot of several hills, and is adorned with agreeable villas and gardens. Gratz is the residence of a bishop, and contains numerous churches and chapels, five monasteries, and two convents. An institution called the Joanneum, where gratuitous lectures are delivered, and which is known as "the pride of Gratz and Styria," was founded by the Archduke John in 1811; it contains very fine collections in mineralogy, botany, geology, experimental chemistry and philosophy, and numismatics, besides a good library. There are also an observatory, a botanical garden with three conservatories, lunatic, orphan, and foundling asylums, six hospitals, and a lying-in institution. Besides the university, which was founded in 1558, there are severel excellent public schools. Gratz has flourishing manufactures of steel and iron ware, cottons, linen, woollen stuffs, silks, ribbons, fans, leather, paper, saltpetre, hats, pottery, &c. From its position on the direct line of railway from Vienna to Trieste, it is very favourably situated as an intermediate station for the trade of the Austrian capital and the Adriatic provinces. It is reputed to be one of the cheapest places in Europe for provisions, and many of the inhabitants are retired officers of the army and persons of rank, with but limited means.

STYRYL'IC ALCOHOL, an alcohol obtained by distilling styracin with caustic potash. It is a crystalline substance slightly soluble in water and having the formula $C_9H_{10}O$.

STYX (Gr. *stux*, from *stugeo*, to hate), a small torrent, near Nonakris, in the north of the Greek province of Arkadia, whose water was supposed to be poisonous, and which was situated in the centre of peculiarly gloomy scenery. It is now called *Fa Mavra-neria*, (the "Black Waters"). In the ancient mythology the Styx was believed to be the principal river of the lower world, round which it flowed seven times. It was considered an arm of the river Okeanos, which encircled our earth, and the river Kôkutos (Cocytus) was thought to be a branch of the Styx. When the gods of the ancients took a great oath, they always swore by the water of Styx, a goblet of which they poured on the ground as they swore, and awful punishment awaited those who swore falsely.

SUA'BIA, SUA'BIAN. See SWABIA, SWABIAN.

SU'AKIN or **SOUAKIN,** a town or seaport in Nubia, on the west shore of the Red Sea, at the extremity of a narrow inlet, about 12 miles in length and 2 in width. The entrance of the bay is only about 60 fathoms wide; it opens gradually to 2 miles, and has a depth of water varying from 15 to 19 fathoms, but it is difficult to enter except with a wind from the south. At the bottom of the bay there are several islands, on one of which Suakin is built. The town is separated from its suburb, called El Geyf, which stands on the mainland, by an arm of the sea about 500 yards wide. The harbour, which is east of the town, is a very good one, and is formed by a projecting part of the continent. The islands and all the surrounding country are sandy, and produce only a few shrubs or low acacias. The houses of the town have one or two storeys, and are constructed of blocks of madrepores. The suburb El Geyf is rapidly increasing in size and population, and is larger than the town itself. Before the outbreak of the Soudan troubles Suakin was the most important trading place on the west shore of the Red Sea. The chief articles of export were cotton, gum-arabic, cattle, hides, butter, tamarinds, senna leaves, and ivory. The imports consisted of cotton goods, iron, wood, carpets, weapons, steel, and fancy wares. Berber in the east, and Kassala in the south, were the great centres for all the caravan traffic of Suakin. All this trade has been stopped, at first by the interference of the hostile tribes, and later by the blockade of the interior kept up by the English garrison. The town is now held (1887) by Egyptian troops under English control, and as the tribes submit the blockade is gradually being relaxed. In the course of the fighting round Suakin an Egyptian force under Baker Pasha met with a severe disaster, and several victories were gained by English troops.

SUB-BASS. In the organ this is the name given to a stop of 32 feet tone, an octave below the bourdon, whose tone it resembles. Hence it is often called *sub-bourdon.* In American-organs the sub-bass is, however, of 16 feet tone, but of very heavy pedal-like character.

SUB-DOMINANT, in music, the fifth below the tonic; that is, the note whose dominant is the tonic. Thus, F is the sub-dominant in the key of C. The simplest modulation known is from a key to its sub-dominant, which is done by adding a minor seventh to the common chord, and the resolution of the discord of the dominant-seventh type thus produced, is the common chord of the sub-dominant, as in the following phrase:—

SU'BERIC ACID, an acid first obtained by the action of nitric acid on cork. It is also produced by acting with nitric acid on some fatty bodies, as castor oil, linseed oil, and oleic and stearic acids.

It crystallizes in long needles, having the formula $C_8H_{14}O_4$. It melts at 140° C. (284° Fahr.), and sublimes at 155° C. (311° Fahr.) in fine needles. It is soluble in boiling water and in alcohol, but not in ether. It is dibasic, forming two series of salts called suberates, and having the general formula $C_8H_{12}M_2O_4$ for the neutral salts, and $C_8H_{12}MO_4$ for the acid salts. These are mostly soluble in water, and from the solutions suberic acid is precipitated by hydrochloric acid. All are decomposed by heat, the suberic acid being sublimed off and the base left as a residue. The aqueous solution of the acid precipitates solution of acetate of lead. Suberic ether ($C_{12}H_{22}O_4$), or ethylic suberate, is a nauseous liquid, having the specific gravity of 1·003. It boils at 250° C. (482° Fahr.), and is soluble in alcohol and ether. With alcoholic ammonia it yields a crystalline substance called suberamide ($C_8H_{16}N_2O_2$).

SU'BERIN is the cellulose obtained from cork.

SUB'INFEUDA'TION, in law, the granting of lands by inferior lords to their dependants. All subinfeudations which existed previous to the reign of Edward I., were confirmed by the 34th of Edward III. The extent to which subinfeudation grew in the feudal system of the Continent was so oppressive to the royal government, that when William the Conqueror was remodelling the simple national feudal system of England, he felt it necessary to take strong measures against so manifest a danger. The feudal barons of France let out their immense estates by subinfeudation in such a way that they had quite armies of followers at immediate command, all owing them personal military service. In this way several of them were

at times each one more powerful than the king himself. Against a combination of two or three together he had no chance. William therefore, in increasing feudal customs in England, granted lands widely divided, and never allowed large contiguous estates to grow up, except in the case of the counties palatine. He also refused to grant separate jurisdictions to the great barons, but rigidly maintained the English customs of the hundred-mote and the shire-mote. He checked inter-marriages of great families, and extorted frequent oaths of fealty to himself from all tenants, no matter who might be their immediate lord. As a consequence, in the strict sense, there never was a feudal government in England, and feudalism existed here only as a system of land tenure, bound by certain feudal usages.

SUBJECT, in music, is the theme or chief melody of any movement; and in pieces of any considerable dimensions it has a companion or *second subject*, contrasted with itself in every possible way. From these two the whole movement springs, their contrast is felt throughout, and the character of every part, even of the episodical matter, bears direct relation either to the one or the other.

In fugue, one of the earliest higher forms of composition to become defined, the subject not only gives rise to the movement, but, rightly considered, it is itself the movement. The second subject begins to show itself in the form of a counterpoint to the subject, for this counterpoint in good examples of fugue is so written as to be available both against the subject in every position, and also as a distinct melody in itself. A curious development of the subject is found in fugue in the form of *answer*, which may be stated very roughly as a repetition of the subject at the distance of a Fifth. The whole meaning of fugue (Lat. *fuga*, a flight) is the appearance and reappearance of the subject chased by the answer until it is actually caught up in the stretto, when one overlaps the other. [See the fine example of STRETTO illustrating the article of that name.]

The rondo, the next completed musical form to fugue, works round to the subject at least three times in the course of the piece, whence its name. The first and second appearances of the subject are followed by an episode contrasting with it. When, however, the majestic sonata form, with its well-defined first and second subject, had been developed, the episodes of the rondo took definite form as a second subject, whose place was to follow the first and the last appearance of the main subject. Beethoven, in adding splendour to this form, enriched it with a third subject, which occupies the middle of the piece, between the second and third times of the main subject, and is heard only once. Each subject is separated from its neighbour by an interval filled with episodical matter, usually quite fresh on each occasion. The rondo, from being among the simplest forms, thus becomes among the most involved.

SUBJECT, in grammar, is the thing about which the sentence is concerned, that of which something is asserted. Every sentence contains a noun in the nominative case, or what represents this, as a subject, and a finite verb which predicates something of this subject. All else is explanatory detail and embellishment. A subject may be a mere noun or an adjective used as a noun, or an infinitive (as "*To err* is human") used as a noun; or any of these modified by adjectives or other phrases. Thus in the sentence "*The method of obtaining silver from lead* is very ingenious," all the words in italics form the subject, and the rest the predicate; but all the subject, except the first two words, is an adjectival extension qualifying the true subject, which is the single noun "method."

SUBJECT, SUBJECTIVE. These words, with their correlatives Object and Objective, are restored to English philosophical language through the medium of the German writers. Subject is used to express the mind, soul, or personality of the thinker—the Ego or I. Object expresses anything or everything external to the mind; everything or anything distinct from it—the non-Ego or not I. The universe itself, when considered as a unique existence, is an object to the thinker; and the very subject itself (the mind) can become an object, by being psychologically considered.

Besides its primary signification, object came to signify motive, end, final cause, &c., by a change common in all language, of a metaphorical into a real signification. Subject, used in this sense, also became synonymous with object, and probably the logical term "subject of predication" facilitated this confusion. Be this as it may, the extreme want of precision with which these two words are often used may be seen in the very common instance of calling anything "a subject of investigation."

Further, rightly considered, the external or object world is but a branch of the subject world. What the external world really may be we none of us know, we know what it appears like to us, and that is sufficient for our purpose. But just as a grain or two of pigment in the lens of our eye would make us see the whole world a bright green or a dull red, so is it with all our perceptions whatever. A dog may see and hear the object universe as quite other than we do; he may even have senses that we know not of. Therefore, it is clear that in this higher sense object is a branch of subject.

SUBJECTIVE METHOD, in philosophy. The study of mind may be regarded as a subject-study or an object-study. The subject is that which knows and feels, the object that which is known or felt by the subject. Each person is subjective to himself, objective to others. Now when one studies one's own mind, one adopts the subjective method of philosophical research; when one studies other minds one adopts the objective method.

It is impossible, in the first place, to do without subjective study, for it is only by understanding our own minds that we arrive at a comprehension of other people's. We must, in the first instance, resort to the introspection of self-observation. But all such introspection is at the same time retrospection; we cannot see the mind at work, we can only remember, more or less truthfully, the phases of past thought or feeling. Under violent emotion we lose all power of observation, we are carried away by a current, of whose nature we have not time to take cognizance. The first great objection, then, to the subjective method is that which caused Comte to declare that mental science, which involves the use of that method, was an impossibility, namely:—"The thinking mind cannot divide itself into two parts, of which one reflects while the other observes it in the act of reflection."

The second objection is that by the nature of the case only one observer can work at once: there is no possibility of checking his results by the independent observation of another.

The third objection is that the subjective method does not give the observer a view of mind, but only of his own mind, and that only for recent mental states. This is what makes self-analysts so profitless, the Hamlets of the world, unable to work out their own ends, since their mind is chained within a narrow circle without hope of escape.

These objections are sufficient to overthrow the contention of those who would limit the study of mind to the old metaphysical subjective method, which can never advance, nor can even gain any solid footing whereupon to stand still. But they do not, as Comte and others asserted, overthrow the possibility of the study altogether; for there remains still the objective method. By this we study the minds of others as shown by their words and acts, especially the facts of childhood and of mental disease; and we further extend the study to the minds of animals as shown in their external manifestation. And these are not so misleading as one would at first suppose, for every thoughtful reader admits that a good biography more often

gives a truthful picture of a man than an autobiography, though the latter gives single touches that are priceless. Among the very little of autobiography that is of actual value to the student of mind is the priceless volume of confessions for which we are indebted to Rousseau, and even in that it is easy to see how the philosopher has quite deceived himself on more than one occasion as to his real mental state. As for works like that of Goethe, they are too sophisticated to be of any use whatever.

The two methods must indeed be used together; but since the objective method allows of a large number of observers upon every mental fact, and also of a large variety of minds to be observed, the chances of error are infinitely reduced; and where the two methods clash, the subjective must give way. A man who knew every corner of his own mind, if ever such a one existed, would be powerless to understand the feelings of an ancient Roman or of a Hindu or of a savage, had he no other light than the subjective one to go by. It is because of this that enlightened superior races ruling over inferior ones, with the most benevolent motives possible, make such terrible blunders. Parents too, who would die for their children, if need were, sometimes cruelly hurt them in mistaken efforts to force their own mental habits and thoughts upon minds to which they are quite alien and injurious. Nothing is more common than for parents to forfeit the deepest affection of their children by misunderstanding them through placing too great reliance upon subjective views; the parents know a little of their own mind, but this knowledge is almost useless as helping them to understand the minds of their children, and the memory of their own minds as children, which might serve them well, has for the most part faded into so dim a picture as to be valueless. Hence the superiority of school over home education; for the teacher deals with all children objectively, studying their methods of thought and their actions, as one studies a curious race of animals, and accepting mistakes as unsuccessful experiments, which, when rightly considered, point out the true way; but the parent, dissatisfied with that external knowledge on account of his too great interest in the child personally, and aiming at a subjective analysis, gets bewildered with frequent error, and fluctuates between over-indulgence and over-severity.

SUB'LAPSA'RIAN (Lat. *sub lapsum*, after the fall), a term used to designate a theory of predestination which regarded the Divine foreknowledge of the fall as preceding the decrees of election and reprobation. In accordance with this doctrine God, having foreseen that all men would fall in Adam and thus become involved in ruin, elected certain out of the fallen race for salvation, leaving the rest to the consequences of the fall. It was opposed to the SUPRALAPSARIAN theory (Lat. *supra*, before, and *lapsus*, the fall), according to which God was supposed to first decree the salvation of some and the reprobation of others, and then to create those already elected or reprobated, and to bring about their salvation or to leave them to their fall.

SUBLIMA'TION is the volatilization by heat and recovery by condensation of a solid body, as distinguished from distillation, which is the vaporization and recovery of a liquid.

The apparatus employed differs widely in form, construction, and material, according to the substance employed. In some cases, as in iodine for example, the most ancient of apparatus, the old alchemists' earthen udel, is still employed. The principal manufactures in which sublimation is required are sal-ammoniac, carbonate of ammonia, sulphur, calomel and corrosive sublimate, zinc and camphor.

SUBLIME has two significations: one, that of the quality or circumstance in objects which raises the emotion of the sublimity; the other that of the emotion itself. The invariable condition of sublimity in objects, either material or moral, is vastness or intensity. The invariable condition of the emotion of sublimity is a comprehension of this vastness with a simultaneous feeling of our own comparative insignificance, together with the concomitant sense of present security from any danger which might result from this superior power.

The sublime is differentiated from the general department of the beautiful, by the fact that the former concerns itself with magnitude almost to the neglect of form, while to the latter harmony, unity, and proportion of form are paramount almost to the neglect of magnitude. The especially sublime effect of height gives the name to the emotion (Lat. *sublimis*, lofty).

SUBLINGUAL GLANDS (Lat. *sub*, under, and *lingua*, tongue), a pair of small salivary glands beneath the tongue, whose secretion is more viscid than that of the parotid glands, and consequently serves to facilitate the transit of the food through the fauces and gullet.

SUBMARINE NAVIGATION. The possibility of constructing a boat that could be navigated under water has presented itself to the minds of mechanicians and inventors for nearly two centuries, but it is only within a recent period that any practical success has been attained. A certain Cornelius Drebell is said to have constructed a boat to be rowed under water at the time of James II., who caused it to be tried upon the Thames, but details of its construction have not been preserved. In 1774 an inventor named Day sank himself in Plymouth Sound in a submarine boat which he intended to bring again to the surface, losing his life through the failure of his attempt. About the same period experiments were made by Bushnell of Connecticut and Robert Fulton in the construction of submarine boats to be used in naval warfare, but in neither case were the attempts more than partially successful. During the present century several boats have been constructed by inventors that could be raised and lowered in the water by their occupants, and within which life could be sustained for a reasonable period, but beyond this their power has been limited and they have failed to pass beyond the experimental stage. Recent developments of torpedo warfare, however, have given a strong impetus to inventors, and during the last few years two or three submarine boats have been designed which are far in advance of all previous constructions. One of these, the design of an ingenious American, was tested in the beginning of 1887 in the Hudson, and during the experiments the engineer in charge showed that he could run readily along the surface of the water, dive beneath it at will, direct his course under water, and ascend without difficulty to the surface again. In one of the experiments he caused his boat to dive under the attendant steamer, and then changing his course under water he came up at a place far removed from where he was expected to rise. In this vessel, which, like all modern boats of the same character, is built of steel and propelled by means of a screw, the motive power is supplied by the caustic soda process, the position in the water or beneath it being determined by means of planes arranged along the side, and the power possessed of manipulating the rudder and screw. Reservoirs of compressed air are carried on board, but for short dives the air contained in the boat is sufficient for the requirements of the crew.

A still more promising design is that patented by Mr. Nordenfeldt, in which a boat, which in the ordinary way moves freely upon the surface, can be forced down and made to move beneath the surface by means of screws arranged along the side. The motive power is supplied by steam, and the depth of submergence is determined by the rate at which the screws are kept working, the boat rising by itself to the surface as soon as their motion is discontinued. Several boats of this design have already been constructed by Mr. Nordenfeldt for use as torpedo boats, and the best mode of defence against their attacks has

now become a subject of serious consideration on the part of naval officers. Another submarine boat of an entirely different design, invented by Mr. Andrew Campbell, and built on the Thames, was submitted to the British Admiralty towards the close of 1886. The plan upon which this was constructed was suggested to the inventor by the consideration that fishes and other animals living in water rise and sink by means of contraction or expansion, and that if a boat could be made in which the displacement could be readily altered the problem of submersion would be solved. The idea occurred, that if the hull of a water-tight vessel was furnished with a series of metal cylinders into which should be fitted rams or drums that could be protruded or withdrawn by a simple process. the buoyancy could be increased or decreased at pleasure, and subsequent experiment proved this to be the fact. Acting upon this idea a cigar-shaped vessel, 60 feet long and 8 feet in diameter amidships, was built, each side of the hull being furnished with three cylinders 2 feet in diameter, and capable of being projected 18 inches. In the trial experiments the boat was lowered almost to a level with the surface by means of water ballast, the cylinders being fully protruded, and then by withdrawing the latter the boat was readily lowered to any required depth. The boat was furnished with twin screws worked by electric engines supplied from storage batteries of large capacity. For safety it was internally divided into four compartments, and in addition to the power of ejecting her water ballast, she was fitted with horizontal rudders and with a heavy movable keel, which, in the case of a breakdown, could be readily detached as additional means of safety. The air contained in the boat was sufficient for the crew for over an hour, a store under pressure being drawn upon when longer periods of submergence were required. The light during submergence was furnished by electric glow-lamps, supplied from the storage batteries used for propulsion. An important feature in this boat was a water-tight egress chamber, by means of which a diver furnished with the Fleuss diving-dress [see DIVING] could be let out under water to operate against a submarine mine or an ironclad overhead.

Submarine boats have the advantage of being out of the reach of shot or shell, a circumstance of no slight importance in these days of machine guns and breechloading cannon, but on the other hand they can never obtain the same rate of speed as those which move upon the surface, they are obliged to proceed in darkness, and no form of torpedo has yet been designed that could be used without danger by a boat itself under water. In connection with the latest American submarine boat it is proposed to range the torpedoes upon the upper part of the boat, and to carry them under the bottom of the vessel to be attacked, to which, on being released, they will adhere by magnetic attraction; a long wire is to be unwound, as the boat moves away, to convey the current necessary to cause the explosion. The idea has the merit of ingenuity, but the difficulties in the way of such a method of attack, and the dangers attending it, are too obvious to need explanation. See also TORPEDO.

SUB-MEDIANT, the name sometimes (but now rarely) given to the Sixth of the scale in a musical key, because it lies at the same distance beneath the key-note (or its octave) as the Mediant or Third of the scale lies above it. As the two notes are not especially connected in musical relationship the term is misleading.

SUBMERGED FORESTS are accumulations of peaty vegetable matter, mingled with the roots and stumps of trees, and occasional broken branches, often occurring in sheltered bays and estuaries below high-water mark, upon coasts that have undergone comparatively recent subsidence. Sometimes they are deeply buried in the beach sand and only exposed after storms; and in some cases they are more or less visible always at low water. They can often be traced for a considerable distance beneath the sea, and the tree stumps being *in situ*, they are obviously the overthrown relics of primitive forests which flourished when the coast area stood at a higher level. On our own shores these interesting indications of former woodlands occur at the same level in almost all sheltered spots; "they may be seen in some of the bays of Shetland, in the Firths of Forth, of Eden, and of Tay, between the Tyne and the Wear, at Hartlepool near the mouth of the Tees, at Hull on the Humber, in the embouchure of the Mersey, at Bournemouth in Hampshire, along the low parts of the southern coast of Devonshire, at Morecambe Bay, at Glasson on the Solway, and in Stornoway Bay in the Island of Lewis" (Page). The trees are mostly Scotch firs, alders, oaks, birches, hazels, and willows; and there are occasional bones and teeth of the animals living in the forests, in addition to rare implements of early man. The latter date back to the newer division of the STONE AGE, and thus afford a clue to the antiquity of the deposits. Professor Boyd Dawkins considers the evidence sufficient to prove that the coast-line of Neolithic Britain approximately coincided with the present 10-fathom line—an elevation which would convert the existing estuaries and bays into wide low-lying plains.

SUB-MINOR INTERVALS, in acoustics, is the term applied to certain intervals which are flatter by a small ratio than the minor intervals in common use. They arise from the subminor Seventh or Harmonic Seventh, which bears the ratio 4 : 7 with the key-note. In the key of C, the B♭ which is the minor Seventh in actual use has not this natural ratio. It is found in practice that it is much more advantageous to use the minor Third of G, the dominant, than the natural or sub-minor Seventh of C; that is, to substitute the ratio 5 : 9 for the ratio 4 : 7, and obtain a B♭ which vibrates faster by 1 in 35. The latter works into a great many chords harmoniously, while the former is useless except in the fundamental discords of the tonic.

Used in its proper place, however, this interval is particularly sweet. Any one who hears it for the first time, on Mr. Ellis's harmonical or other specially tuned experimental instruments, is sure to be struck with the absence of discordance. In fact, on theoretical grounds, apart from audition, it is more consonant than the minor Sixth. It is only after actually hearing a sub-minor Seventh that we can understand how the long chord of partials in an ordinary musical tone can combine to form a harmonious and apparently single stream of sound.

The sub-minor Third, ratio 6 : 7, is also a closer interval than the ordinary minor Third (which has the ratio 5 : 6) by one vibration in 35, and therefore closely resembles the sub-minor Seventh in many particulars. It does not occur in ordinary music, but in instruments of perfect intonation, and in the chord of partial tones, it is the interval between the dominant and the sub-minor Seventh, and is found in the second octave from the prime tone.

The sub-minor Fifth, ratio 5 : 7, is in like manner a narrower interval than the true minor, or imperfect, Fifth; and occurs in theoretically tuned instruments between the Third and sub-minor Seventh of the scale.

SUBORNA'TION, in law, signifies the offence of procuring another to commit a crime, the term being most generally applied to the procuration of perjury. In former times the offence was punishable by death, the penalty being by degrees reduced to the cutting out of the tongue, banishment, forfeiture of goods, and lastly to fine and imprisonment, at which it stands at present.

SUBPŒ'NA, in English law, is the name given to a writ commanding attendance in a court under a penalty. The *Subpœna ad testificandum* is that which compels the

personal attendance and giving of evidence on the part of a witness, the *Subpœna duces tecum* being used when a person has in his possession any book, instrument, &c., the production of which in evidence is desired. Both must be personally served. Witnesses subpœnaed to give evidence on the trial of actions must attend at the time and place specified in the subpœna, and in return they are entitled to claim from the party in behalf of whom they have been subpœnaed, a reasonable allowance for travelling expenses and loss of time, and this whether their evidence is given or not. When subpœnaed on the part of the crown in criminal and other cases a witness is allowed his travelling and other expenses according to a fixed scale of allowance, in proportion to his position in life. A witness who appears for the defence at a preliminary inquiry before a magistrate previous to the committal of a prisoner, and who is bound over to give evidence on the trial, may, by order of the presiding judge, receive an allowance for travelling and other expenses after the same rate as witnesses on the part of the prosecution.

In Scotland the term "subpœna" is not used. The corresponding word is "citation," but the meaning and general effect are similar.

SUB'SIDY, from *subsidium*, a Latin word signifying aid or assistance. "Subsidies," says Lord Coke, "were anciently called *auxilia*, aides granted by Acts of Parliament upon need and necessity; as also for that originally and principally they were granted for the defence of the realm and the safe keeping of the seas," &c. The word, used in its general sense, was applied to aids of every description.

SUBSTANCE, in general usage, means a solid. In philosophical speculations it has undergone the fate of most general terms, and has been tortured into all possible shades of meaning. In physical speculations it has usually been taken as equivalent to matter; but in metaphysics its meaning has remained true to its etymon (*substans*, that which *stands under* phenomena).

As we know that all phenomena must depend upon noumena, of which they are only the manifestation; or, to use the language of the schoolmen, as all accidents must be accidents of something, and must depend on that something for their existence, so in pushing our analysis to its limit, we must finally arrive at a point to which we can give no antecedent, which we are forced to assume as final, and as standing under or supporting the whole, and this we call Substance. It is the fundamental fact of all existence. We can never know it, for we know only phenomena, which are its appearances. We can never conceive it, for the first attempt to conceive it brings it within the sphere of our ideas, which are only those of phenomena. We can never imagine it, but we are compelled to assume it. The meaning may be rendered more intelligible by a reference to the notion of some Hindu philosophers, who supposed the world to rest on the back of an elephant, and that the elephant stood on the back of a tortoise, but what supported the tortoise they omitted to explain. Adopting their theory, we may add that that which the tortoise stood upon was substance.

Substance is as necessary, as the basis of all speculation, as the "point" in mathematics, but, like the point, is for ever a mere logical distinction. Glass is a substance; at least it is so called in common language. Analyze it, and it will be found that it is no substance—that it is merely the coexistence of flint and alkali. Our substance, then, has vanished with the analysis. It was found to be flint and alkali, nothing more; no distinct element, no substratum was discovered. Analyze the flint in the same way, and it will be found that the flint is no substance, but a mode of existence of some particles of silicon and of oxygen. And yet the mind refuses to admit that this analysis could be so continued *ad infinitum*, thus reducing everything to mere phenomena; it is impelled to stop somewhere, and to ask "attributes of what?" and there, where it stops, it recognises substance. Hence Spinoza's definition of substance being existence itself. We can only say, then, that substance is the unknown, unknowable substratum on which rests all that we experience of the external world; it is the hidden noumenon whose manifestations, as presented in perception, we call matter, and the phenomena of matter, and of which every positive predicate must necessarily be false, and consequently all inquiry into its nature baseless.

SUB'STANTIVE. See NOUN. The two words are used almost interchangeably, except by those who regard as nouns adjectives as well as substantives.

SUBSTITU'TION. This chemical term, in its widest sense, may embrace all cases of decomposition, where, by the action of any given substance, B, whether simple or compound, organic or inorganic, any element of an organic compound, A, is withdrawn wholly or partially, and its place in A is supplied by an equal number of atoms of B, so that we may presume that the atoms of B take the place formerly occupied by the substance which has been removed. Consequently not merely the number of atoms in A, but their relative position remains the same.

One element, carbon, is never removed by substitution. This element may be considered as the essential principle of organic compounds, whose character is determined by the number of its atoms, no other substance being able to take its place. Even the diminution of the number of carbon atoms in a compound entirely alters its character, at once removing it into another series.

The removal of any one of the elements of an organic compound by the action of any substance is not always followed by a true substitution. Thus sometimes certain constituents of a compound body are displaced without any substitution. Thus the oxygen of nitric acid takes from alcohol ($C_2H_6O_2$), two atoms of hydrogen; so we have remaining aldehyde ($C_2H_4O_2$). In like manner, one atom of atmospheric oxygen removes one atom of hydrogen from indigo-white (C_8H_6NO), and there remains indigo-blue (C_8H_5NO).

Sometimes the substance withdrawn is incompletely replaced by its successor. Thus if a current of chlorine gas is passed into alcohol five atoms of hydrogen are withdrawn, but only three atoms of chlorine take their place in the newly-formed compound, chloral.

Sometimes, again, the compound, after substitution, contains more atoms than it did previously. This may happen either when the compound formed by the substitution of the corresponding number of atoms of the introduced substance takes up, outside the nucleus, an additional number of them; or when it retains in a state of loose combination the compound formed by the union of the abstracted substance with the decomposing body. Of the former case we have an instance in olefiant gas (C_2H_4), which, when acted on by chlorine gas under direct sunlight, becomes C_2Cl_6. The latter case is exemplified in benzole (C_6H_6). When this body is acted on by chlorine in excess it yields

$$C \begin{cases} H_6 \\ Cl_6, \end{cases} \text{or more properly } C_6 \begin{cases} H_3 \\ Cl_3 \end{cases} 3HCl;$$

and when the 3HCl are removed by washing with potash, the true substitution product remains $C_6 \begin{cases} H_3 \\ Cl_3. \end{cases}$

In many organic compounds it is possible to remove completely by substitution one of the constituents, *e.g.*, hydrogen, if the replacing substance be allowed to act

in sufficient quantity and under fitting circumstances. In these cases, as atom after atom of the removable body is withdrawn, the compound under action passes through a series of definite intermediate stages until one of its original elements is finally eliminated. Thus hydrochloric ether, when continually acted upon by chlorine at proper temperatures, passes from $C_2\left\{\begin{matrix}H_5\\Cl\end{matrix}\right.$ first into $C_2\left\{\begin{matrix}H_4\\Cl_2,\end{matrix}\right.$ then $C_2\left\{\begin{matrix}H_3\\Cl_3,\end{matrix}\right.$ then $C_2\left\{\begin{matrix}H_2\\Cl_4,\end{matrix}\right.$ $C_2\left\{\begin{matrix}H\\Cl_5,\end{matrix}\right.$ and at last into C_2Cl_6.

In other compounds only a portion of the atoms of hydrogen can be removed by substitution.

It must be understood that although the most striking cases of substitution are afforded by organic bodies, yet we may distinctly trace the same principle among inorganic compounds. Thus if we take a solution of sulphate of copper, and allow metallic iron to act upon it, the copper is eliminated in the metallic state and the iron takes its place, forming sulphate of iron.

Substitution may take place in the following ways:—(1) One or more atoms of the displacing body unite with one or more atoms of the removable element, forming a separate compound, while other atoms of the former, equal in number to the abstracted atoms of the removable substance, enter the original compound. (2) A compound body acts upon the organic substance, one of its constituents uniting with the removable substance, whilst another portion takes the place of the latter in the original compound.

Hydrogen, the element most frequently substituted, is replaced by chlorine, bromine, and iodine, by oxygen, by metals, by hyponitric acid, by sulphurous acid, and by organic radicals. Substitutions of this last kind form the interesting and important compound ammonias. Thus in diethylamylamine, two of the three atoms of hydrogen in common ammonia (NH_3) are replaced respectively by ethyl and amyl, and the result is $N\left\{\begin{matrix}H\\C_2H_5\\C_5H_{11}\end{matrix}\right.$

Chlorine, bromine, and iodine may be replaced by hydrogen, amidogen, and sulphur, probably also by selenium. Hyponitric acid may be replaced by amidogen and nitrogen; oxygen may also be replaced by the same two bodies, as well as by sulphur and tellurium.

SUBTENSE means any line, angle, &c., opposite to or subtending a line or angle spoken of. Thus the chord of a circle is the subtense of the arc and also of the angle at the centre. The term is now not much used.

SUBTERRANEAN FORESTS are accumulations of vegetable matter, involving roots, stems, branches, leaves, and fruits of trees, lying below the surface of the earth, and generally covered with peat to a greater or less depth. These differ from SUBMERGED FORESTS in not being limited to any particular level nor to a close proximity with the sea. Such forests are found in various parts of the United Kingdom and the Continent.

SUBTRACTION. The process of subtraction is the removal from the greater of two quantities of a part equal to the less. The quantity to be diminished (*minuendum*) is called the minuend; the quantity to be withdrawn (*subtrahendum*) the subtrahend; and the remaining part the remainder or difference.

It is obvious enough that if parts of A be subtracted severally from greater parts of B, the remainders put together make up the whole remainder. Thus 24 can easily be taken from 76, for 7 tens exceed 2 tens by 5 tens, and 6 exceeds 4 by 2, so that 52 is the remainder required. But when we come to take 48 from 93, the preceding mode of partition is useless. To remedy this it is proposed in the explanation to borrow one of the 9 tens in 93, and to put it on to the 3; then 8 from 13 leaves 5. Now take the 4 tens of 48, and subtract from the remaining 8 tens of 93, and 4 tens are left; the answer then is 45. The process would be as follows:—

93 48 — 45	8 from 3, impossible: borrow a ten from 90; 8 from 13 leaves 5. Take 4 tens from the remaining 8 tens, one of the 9 tens having been borrowed, and 4 tens remain.

This process (the only correct one) has long been actually used on the Continent, and is daily growing more in use among ourselves. The old-fashioned and rather absurd method, still the most usual with us, is as follows:—

93 48 — 45	8 from 3, impossible: take 8 from 13, and 5 remains. Carry 1 to 4, giving 5, and subtract 5 tens from 9 tens, giving 4 tens.

There is quite a different principle involved in this process, which is:—If two numbers be equally increased or equally diminished, the difference remains the same. Thus a father and son, though their age increases with every year, always remain at the same difference of age through life. Consequently, as we have arbitrarily increased the 3 in the upper line by ten, the lower line must be also increased by ten in order to keep the difference (which is all that is wanted) unaltered.

The object has been above attained by increasing the upper line by ten units, and the lower line by a ten. A better way of working it, because introducing no confusion of thought, is to consider, in the example just given, what will make up 13, starting from 8, and then to write down the answer and carry 1, adding it to the next place in the subtrahend. The great point is to write down the italicized answer as we utter (or think) it in each case. Example: Take 7907 from 12134. Wording:—

12134 7907 —— 4227	7 and *seven* make 14, carry 1; 1 and *two* make three; 9 and *two* make 11, carry 1; 8 and *four* make 12.

If we chose to add other numbers instead of tens the result is exactly the same, provided the addition is fairly made to both lines. Thus we may say 7 and *twenty-seven* make 34, carry 3; and here we have written down 27 already, which is correct, as 3 and *nought* make 3; so that our 2 in the tens place is unaltered. The proof will be found easy to pursue further, and not without amusement to the student.

SUBULA'RIA, is a genus of plants belonging to the order CRUCIFERÆ and the tribe Subularieæ. *Subularia aquatica* (Awlwort) is a native of the northern parts of the world, in ditches, lakes, and rivulets with a sandy or gravelly bottom. It is found plentifully in the north of England, Scotland, and Ireland. It is a minute stemless plant, with a root consisting of a tuft of long white fibres, from which spring a few very narrow awl-shaped leaves and a flower stalk, about 2 inches high, bearing a few scattered small white flowers which expand and fruit under water.

SUCCEN'TOR, the name given to the deputy of the precentor of a cathedral, whose function it is to regulate the performance of divine service. The office has much revived in importance of late years, owing to the greater pains now spent upon the musical and other details of the service.

SUCCESSION is a legal term derived from the Roman *successio*, which signifies a coming into the place of another; and successor is, consequently, he who comes into such place.

The Roman term signifies a coming into the place of another so as to have the same rights and obligations with respect to property which that other had. There

might be a successio either by coming into the place of a person living, or by becoming the successor of one who was dead. Gaius (iii. 77, &c.) gives instances of successio in the case of persons living, one instance of which is the Bonorum Cessio according to the Lex Julia. Succession was again either universal or singular. The instances of universal succession (*per universitatem*) which Gaius (ii. 97) enumerates, are the being made a person's heres or heir, getting the possessio of the bona of another, buying all a man's property, adopting a person by adrogatio, and admitting a woman into the manus as a wife; in all which cases all the property of the several persons enumerated passed at once to the person who was made heres, or got the bonorum possessio, or bought the whole property, or adopted another by adrogation, or married the woman. An instance of singular succession is the taking of a legacy under a man's will.

The term Succession is used in our language. We speak of the SUCCESSION TO THE CROWN or the regal dignity, and the term implies that the successor in all things represents the predecessor. The king, as a political person, never dies, and upon the natural death of a king the heir immediately succeeds. The English heir at law takes the descendible lands of his ancestors as universal successor, and the executor takes the chattels real and other personal property of his testator as universal successor. The general assignee or assignees of a bankrupt or insolvent take by universal succession.

In theology, apostolical succession is the uninterrupted succession of priests in the church by regular ordination, from the first apostles down to the present day. The doctrine of apostolical succession is the belief that the clergy thus regularly ordained have a commission from God to preach the gospel, administer the sacraments, and guide the church, and that through their ministration only we can derive the grace which is communicated by the word and sacraments. Hence, according to this doctrine, those bodies of Christians whose pastors have not this regular succession have, properly speaking, neither church nor sacraments. This doctrine is maintained by the Roman Catholic priesthood, and by the high church party in England, but it is wholly repudiated by all other Protestant churches.

SUCCESSION DUTY. Until the year 1853 all freehold property on devolution by death or other means was entirely exempt from any duty, in contradistinction to personal property, which was chargeable with legacy duty. However, by the 16 & 17 Vict. c. 51, the policy of the law was changed, and it was enacted that every past or future disposition of property by reason whereof any person had or should become beneficially entitled to any property, or the income thereof, upon the death of any person dying after the 19th May, 1853, either immediately or after any interval, either certainly or contingently, and either originally or by way of substitutive limitation; and every devolution by law of any beneficial interest in property, or the income thereof, upon the death of any person dying after the time above mentioned, to any other person in possession or expectancy, should be deemed to have conferred or to confer on the person entitled, by reason of such disposition, or devolution, a "succession." The Act further fixes the duties on succession, the amount thereof depending on the relationship of the successor to the predecessor, the person from whom the interest of the successor is derived. Lineal descendants pay 1 per cent. on the value of the property; brothers and sisters, or their descendants, 3 per cent.; uncles and aunts, 5 per cent.; great-uncles and great-aunts, 6 per cent.; and strangers in blood, 10 per cent.

It will be seen that the scope of the Act is a very wide one, and that its intention, shortly stated, was to impose a duty corresponding to the legacy duty on all successions to personal property under settlement, and to real and leasehold property under settlement, will, or intestacy. But in dealing with real estate, a singular exception from the general principle of the taxation of successions is made. This general principle is that, having ascertained the value of the succession, whether it takes the shape of a legacy, or a share of residue, or an annuity, the duty is to be levied on such value, and the value in all cases of succession and legacies, except in the case of real and leasehold estate, is the marketable value, *i.e.* what the subject is really or presumably worth. Thus a legacy of £1000 consols pays the duty on the value of consols at the time when the legacy is satisfied; a bequest of pictures and furniture, on the saleable value, to be fixed by a competent person. But if the succession is to 100 acres of land, worth say £5000, then, instead of levying the duty on the £5000, the value of the succession is ascertained in this way: the annual value is stated and the outgoings therefrom, and the net income is found; then the age of the successor; and then recourse is had to the succession duty annuity tables, and the value of an annuity equal to the net income for the life of the successor is calculated, and on this value the tax is levied by eight half-yearly instalments. This arrangement is of course quite just when the successor is only entitled to a life interest in the property, but it seems to rest upon no sound principle when the succession is absolute. And it is decidedly disadvantageous to the revenue, for in the case supposed, of an absolute succession to 100 acres of land, worth to sell £5000, say that the net annual value is £150, and the successor is thirty-five years of age, then the value on which the tax would be charged would only be £2362, or less than half of the real value; and if the successor were older, the value would be much less still, and in no case could it exceed £2890. The singularity of such a basis of taxation is made more apparent if we suppose that, instead of the acres being devised as land, the testator directs them to be sold and the money paid to his legatees; then the amount realized by the sale, being the real value of the succession, would be charged with the duty.

There are exceptions made by the Act from this general principle of taxing successions to real and leasehold property by way of annuity in the cases of property devolving (1) for charitable or public purposes, or (2) upon any body corporate, company, or society. In both these cases the principal value is to be ascertained, and the duty at 10 per cent. charged thereon, and in the first description of successions this duty is to be raised and paid immediately, in the second it may be paid by instalments.

The Act allows a deduction from the gross annual value of all "necessary outgoings," but this term does not include "income tax" or salaries paid to agents for managing the property or for collecting the rents; in short, only such outgoings as are intrinsically necessary, as, for example, repairs and insurance.

Annuities charged on the property are allowed to be deducted, and when they expire a further duty is payable on the benefit thus obtained by the successor. In the case of ground rents, the annual value is the rent reserved at the time when the account is delivered; but when the lease runs out and the successor obtains a further benefit, either in the shape of increased income or of a money payment, the duty is charged, or, if he grants a reversionary lease for valuable consideration, the duty is payable on what he thus gets.

Charges incident to the tenure of the property are allowed as deductions, such, for example, as fines paid on admission to copyholds, and of course the interest upon any mortgages is allowed, provided they were not created by the successor.

If the successor, before he becomes entitled in possession, expends money on substantial repairs or permanent improvement of the property, he is entitled to an allowance, and

if, on taking a succession, he is bound to relinquish or is deprived of any other property, he is entitled to have the value of such property deducted from the value of his succession. A very wide application has been given by judicial decisions to this class of deductions, and the revenue has suffered most severely in consequence; every sort of benefit which a successor loses when he takes a succession is considered to entitle him to a deduction, whether it is connected or not with the succession, and whether the "property" of which he is deprived is existing or not; thus an allowance is made for an annuity which terminates by death, although it is hard to imagine that this was intended to come within the terms of "property" which is bound to be relinquished, or of which a successor is deprived.

Where there is timber on an estate, and sales exceeding £10 net in any one year are made, the moneys produced by these sales are chargeable with duty; if the timber is used on the estate, or is cut and exchanged for other wood more suitable for use, and no money passes, the duty is not leviable.

The persons accountable for the duties are the successor and the trustees, guardians, committee, tutor, or curator, or husband, in whom any property subject to the duty is vested, and any person who has acquired the succession by alienation or purchase at the time when it falls into possession; and these persons are authorized to raise the duty out of the property by mortgage or otherwise; they are required to give notice to the Commissioners of all successions and to deliver the particulars to them in the shape of an account, and to pay the duties when assessed, and penalties are imposed for neglect on their part, and the duties are to constitute a debt. Further protection is afforded by making the duty a charge on the property itself, so that the question as to whether or not the succession duty has been satisfied is one of the ordinary requisitions on title when properties are being sold, and the commissioners are required to furnish certificates to interested parties, *i.e.* vendors or purchasers, of the due payment of the duty.

Interest at 4 per cent. is charged on duties in arrear, and discount at the like rate is allowed on duties paid in advance; and the payment of duty under discount does not prejudice the right of the successor to a return if such a right should arise; for example, if a house is devised to A for life at the death of B, and B dies in January, 1887, the first instalment of duty would be due in January, 1888, and the remaining seven at half-yearly intervals. A, however, tenders the whole duty under discount and afterwards dies in March, 1888, when only one instalment is due. His representatives are entitled to a return of the other seven instalments, less discount.

If A had been entitled to a fee-simple or continuing interest, there would have been no right to a return. This is the only difference made by the Act between a life and an absolute succession to real and leasehold property.

When the succession duty was adopted it was estimated that it would produce £2,000,000 annually, but those who opposed the bill estimated that it would be nearer £4,000,000. It has never yet reached £1,000,000.

SUCCES'SION WARS. The term is not held to cover such contests as the Wars of the Roses in England, where the claim of a pretender to the crown is being resisted by the king *de facto*, whether that claim be superior to the king's or not. Rather, the term is limited to the case of two or more claimants for an empty throne, the royal line previously occupying which has died out, or has failed to maintain its claim to succeed upon the death of the last monarch.

Five such wars claim notice as having profoundly disturbed the peace of Europe.

I. *War of the Palatine Succession.*—This rose from the just claim of the Roman Catholic Philip, count palatinate of Neuburg, to the succession of the Lower Palatinate, on the failure of the Protestant line of Simmern. (One of the princes of this line was Frederick the unfortunate "Winter King," who married the sister of our Charles I., and whose sons, Rupert and Maurice, figure largely in our Civil War, while his daughter Sophia married the Elector of Hanover, and so became the mother of our George I.) The claim of Count Philip was derived from as far back as the father of that Elector Ludwig III. who married a daughter of Henry IV. of England, but old as it was it proved the best available. His religion was the real stumbling-block; nevertheless, by astuteness he managed to conciliate his subjects, while re-establishing the Roman Catholic religion. It is noteworthy that on hearing that his envoy had opened a Roman Catholic chapel in Lime Street, London, encouraged by King James II., and had caused a tumult in consequence, he at once sent orders to have it closed. "I too," he wrote to James, "have Protestant subjects, and I know with how much caution and delicacy it is necessary that a Catholic prince so situated should act." Macaulay points out that instead of James expressing gratitude for the elector's considerate conduct he turned the letter into ridicule, and kept the elector's chapel open against his own order, at the same time bringing a large body of troops to Hounslow to overawe the town. Two years later James was a fugitive. So indeed was the elector, but from a different cause. Louis XIV. of France, in the course of his long duel with William of Orange, suddenly threw his forces upon Germany and gained victory upon victory, while William busied himself in acquiring the crown of England. Upon some shadowy claim of his brother's, the Duke of Orleans, who had married a princess of Bavaria after the death of his English wife, daughter of Charles I., Louis claimed the Palatinate, and enraged at its resistance to his arms he issued an order, signed by Louvois, for its devastation. French arms had already ravaged the unlucky country in 1674, but this second punishment was frightful. Forty towns and many villages were set on fire, the graveyards were purposely profaned, and in fact such horrible cruelties were perpetrated that Louis overshot his mark and three armies were speedily on foot in Germany quickened with revenge. Elector Philip died in exile at Vienna, 1690. His son's efforts to overcome the French occupation led to a second ravaging in 1693; but the peace of Ryswick placed him (John William) at last upon the throne in 1697. The intention of the allies was to secure the state to Protestantism, but a clause was surreptitiously introduced by Louis agreeing that the Roman Catholic religion "as now established" should continue, and this was afterwards provocative of much trouble.

II. *The War of the Spanish Succession* almost immediately afterwards broke out; originating in the successful attempt of Louis XIV. to place his grandson Philip, duke of Anjou, on the throne of Spain (left vacant in 1700 by the death of the childless Charles II. of the house of Austria), although both Louis and the Spanish cortes had solemnly sworn that no such claim should ever be preferred. Europe divided on the point, England throwing in her lot with the Austrian claimant. War was declared in 1702, and the great victories of Marlborough and Prince Eugène have made it memorable. Blenheim (1704), Ramillies (1706), Oudenarde (1708), and Malplaquet (1709) destroyed the fame of the French arms, powerless before Marlborough; but Tory domestic intrigues prevented that great captain from finishing his work, and the peace of Utrecht (1713) left France still a danger to Europe. By that peace the Bourbon, Philip V., was left in possession of the crown of Spain, while Austria was consoled with the Netherlands and the Milanese. England retained Gibraltar, Minorca, Hudson's Bay, and Nova Scotia—her cost in the war, as measured by the rise of the national debt, being, £22,000,000.

III. *War of the Polish Succession.*—Twenty years

afterwards the death of August "the Strong," King of Poland and Elector of Saxony, caused a short sharp war. Stanislaus Leczinsky, who, under protection of Charles XII. of Sweden, had been King of Poland from 1704 to 1709, had then made way for August the Strong again. In 1725 his daughter was married to Louis XV. of France, and Stanislaus now (1733) put forward for the throne of Poland. Austria and Russia had fixed upon a prince of Portugal, and had moved armies close to the frontier to "preserve freedom of election." However, August of Saxony, son of the late king, succeeded in winning the favour of the emperor by joining in his views on the Pragmatic Sanction (cause of the next Succession War), and through Austria he prevailed also with Russia. Meanwhile Stanislaus had arrived in disguise, presented himself to the Diet and received election, 12th September, 1733. French help had been promised him, but there seems reason to suppose that it was never really intended, and that he served as a catspaw for the French minister Fleury, anxious for a war that he might seize upon Lorraine. On hearing of the news of Stanislaus' election the Russian army of 50,000 men advanced on Warsaw. King Stanislaus reigned but ten days and then fled to Dantzic, where he held out against a blockade and a siege, from February to June, 1734. August III. was now elected by twelve senators and about 600 gentlemen on the 5th October, under cover of the Russian army, which then withdrew, leaving Poland to murder, robbery, and anarchy from the partisans of the two kings. The actual Polish War ended with the flight of the ex-king from Dantzic in disguise, 27th June, 1734, and the break-up of the siege in consequence: but it caused a two years war between France and Austria, fought chiefly in Italy and the Rhine country—in the former Don Carlos sweeping the Austrians from Naples, Villars sweeping them from Milan; in the latter, Frederick the Great (then crown prince) serving his first campaign, which went steadily against the emperor. In 1736 therefore preliminaries of peace were signed, and France was almost able to dictate terms. Carlyle says truly that "never before had Kaiser such a bill of broken glass to pay for meddling in neighbours' elections" ("Frederick the Great," Book ix.) Difficulties about the Pragmatic Sanction delayed the treaty of Vienna till 1738; but its chief terms when completed were these—(1) The relinquishment of the kingdom of Naples to Don Carlos of Spain against the Duchies of Parma and Piacenza—a poor compensation. (2) Recognition of August III. as king of Poland, against recognition of the title of king to be worn by the exiled Stanislaus. (3) Stanislaus to receive as compensation the duchy of Lorraine, and the Austrian Duke of Lorraine to become the Duke of Tuscany. Lorraine to fall to France at the death of Stanislaus. (4) France to agree to the Pragmatic Sanction.

IV. *War of the Austrian Succession.*—On the death of the Emperor Charles VI., 20th October, 1740, only two years after the treaty of Vienna, which closed the War of the Polish Succession, the male line of the Austrian house of Hapsburg became extinct. Charles had, however, a daughter, Maria Theresa; and he spent all the latter part of his reign in endeavouring to get the sanction of the great powers to a solemn act of his own, called the Pragmatic Sanction (*i.e.* Solemn Imperial Decree), given in 1713 and decreeing that all his dominions should descend intact to his daughter. For this object he undertook wars and negotiated alliances, lavishing treasures and men upon this project. Nevertheless immediately upon his death war broke out. France at once repudiated the treaty of Vienna, Frederick the Great of Prussia revived forgotten claims upon Silesia, and poured troops across the frontier. Charles Albert, the Elector of Bavaria, put forward his claims to the Austrian Succession, which, to do him justice, he had never concealed. In 1741, France, Bavaria, and Prussia were joined by Spain, claiming Italian possessions, and Sardinia claiming the Milanese. England, in pursuance of her adhesion to the Pragmatic Sanction, sent the distressed queen a subsidy of £500,000, and Parliament voted a further sum of £5,000,000 to carry on war on her behalf, and about 40,000 men were sent to Germany. The Dutch were friendly, and her Hungarian subjects were true to their promise to the queen at her coronation—"Moriamur pro rege nostro." By abandoning Silesia, Maria Theresa bought off Frederick of Prussia: and she then defended what remained of Bohemia on the one hand, occupied as it was for the most part by French troops under Belleisle, and brilliantly attacked Bavaria on the other, her generals entering her rival's capital of Munich on the very day when, as Charles VII., he was being crowned Emperor of Germany at Frankfurt, 12th February, 1742. Such success alarmed Frederick, and he abruptly renewed the war, attacking Bohemia. England and Holland exerted themselves, however, drove out the French and Bavarians from Bohemia, and stayed the action of both Sardinia and Naples. The new emperor regained for a few months his own electoral dominions of Bavaria, but lost them in 1743, and was so disheartened that he retired from the contest and made peace: Prussia had done the like, and therefore of all the huge coalition only France and Spain now remained. In the campaign against France, King George II. won the victory of Dettingen, 27th June, 1743, the last time an English monarch ever fought in person.

In 1744 England became still more active, and herself declared war against France, no longer acting merely as the ally of Austria. The King of France himself led his armies in Flanders. But by British ships the seas were swept clear; and Frederick, once more alarmed for his new possessions in Silesia, declared war a third time, and allied himself with France, the Elector Palatine, Sweden, and the emperor. He dashed upon Bohemia in his sudden manner, but he narrowly escaped being cut off by the Hungarians, who were more ready than he supposed. His action had, however, freed Bavaria, and the unhappy emperor could now once more regain it. The arms of Austria were now in the ascendant, and Spain was driven downwards along Italy. In 1745 the emperor died, and his successor in the electorate of Bavaria was only too desirous to make peace. The peace of Dresden, 25th December, 1745, also withdrew Prussia finally from the war. These victories in the field and the council chamber were balanced by disasters in the Netherlands, where Marshal Saxe won fortress after fortress (although one defeat of the campaign was almost as glorious as a victory for the allies, namely, that of Fontenoy, 11th May, 1745), and by a still greater overthrow in Italy, which this year saw entirely in the hands of Spain. On the other hand, in 1746 several Italian successes were gained, and the death of the poor mad King of Spain about this time was even a greater piece of good fortune to Austria, as the new monarch held altogether different aims from those of the previous government. But the victories of Saxe continued disastrously, and the following year (1746) saw him equally fatal to the towns of Holland. The Duke of Cumberland was totally routed in this campaign at Laffeldt, and altogether England and Holland were so tired of the unequal contest, though during 1747 the English won two victories at sea (Finisterre and Belleisle), that in 1748, against the protestations of Austria, they insisted on bringing the war to a close by the treaty of Aix-la-Chapelle, 18th October, 1748. After all the long and severe contest, Maria Theresa retained most of what she had been entitled to by the Pragmatic Sanction, losing part of her Italian provinces and all Silesia. England, who had made enormous sacrifices, received practically no benefit, for the expulsion of the old Pretender from France could scarcely be held of

much moment. One of the results of the war was the founding of Halifax, Nova Scotia; for the number of discharged English soldiers and sailors was so great that they were encouraged to emigrate to the new colony by a grant of a passage and 50 acres free to each, with a small sum of ready money and immunity from taxes for ten years.

V. *The War of the Bavarian Succession*, commonly called the "Potato War," broke out in 1777. Beyond the actual mustering of troops this was a war only in name. It was a strife of diplomacy, and gained its name from the soldiers having nothing to do but to cook their potatoes by the camp-fires, while the diplomats wrangled in their council chamber. The death of Maximilian Joseph of Bavaria (he who had refused to continue the contest with Maria Theresa) took place in 1777. The Emperor Joseph (son of Maria Theresa) laid claim to Lower Bavaria, marched upon it, and took possession of it. The new elector made terms by which he retained possession of one-third of the territory, and gave up two-thirds; but his heir protested against this arrangement and played upon the jealousy of Frederick the Great, till the latter took up arms and marched once more into Bohemia. Austria wisely yielded, and was perforce content with a simple acquisition of territory, abandoning the rest to Bavaria by the peace of Teschen, 13th May, 1779.

SUCCESSION TO THE CROWN. This is now in all countries hereditary, but in none was it so originally, and least of all in our own country. The ancient English monarchy was elective. The royal succession was limited to the reigning family, and it was the custom to choose the eldest male of that family of full age and capacity. In fact the only exceptions to this were the elections of Cnut (1017) and Harold (1066). It was not until Edward II. that the strict hereditary principle was acknowledged. If an eldest son were often chosen, it was chiefly as nominee of the late king. Such a nominee always had a great advantage if he was respected by the witan. It was on this account that Harold was elected, being nominated by Edward the Confessor. and it was rather because of an alleged previous nomination by Edward that William of Normandy claimed as against Harold, than because of his distant relationship to the Confessor. Edward's mother, Queen Emma, was a Norman princess by birth, and was William's great-aunt.

We find Ethelred I., brother of the late king, chosen in 866 in preference to his young nephew; and Alfred the Great in 871 chosen over the sons of his brother Ethelred. Edward the Elder followed his father Alfred after our modern fashion, but was succeeded in 925 by his illegitimate son Athelstan, who had already shown his exceptional worth as a warrior and ruler, and had in early childhood been a favourite of Alfred the Great, as against the legitimate sons of Edward, who were much younger and as yet unknown. A Athelstan's death his half-brother Edmund succeeded, but though Edmund left two sons (Eadwig or Edwig and Edgar), these were set aside as too young to reign, and Edmund's brother Eadred was chosen (946). Finally, when the Danish sovereigns died out with Harthacnut, and an English king was once more elected, it was Edward (the Confessor), the half-brother of the last English king, Edmund the Ironside, who was elected, notwithstanding the fact that Edmund had left two sons. These were Edward and Edmund, the "Athelings" (or as we should say, the crown-princes), who had been sent safely away to Hungary out of reach of the Danes. Edmund died there. Edgar lived until 1057, when he died, just after landing in England to pay a long promised visit to his childless uncle, King Edward the Confessor, that he might be adopted as successor to the crown. It was the son of this prince whom we know as Edgar the Atheling, and he and his father, as the son and grandson of Edmund the Ironside, should have been kings by our modern notions, to the exclusion of Edward the Confessor. The non-hereditary succession of the crown at the time is shown by the fact that the fight lay entirely between Harold and William, the brother of the queen and the great-nephew of the queen-mother respectively, Edgar, the lineal heir, being quite out of the contest. He was chosen as king at London in 1066 by a small party led by the earls Edwin and Morkere, but his candidature was almost at once dropped by the leaders who had promoted it, and Edgar made haste to submit to William the Conqueror. Edgar's sister married Malcolm of Scotland, and had a daughter, Matilda, sole representative (after Edgar's death) of the English royal house of Cerdic. By marrying this princess Henry I. of England united the English and Norman successions.

Turning to the Norman kings, we see the elder brother Robert set aside by the great council in favour of the younger brother William (Rufus). William II. was childless, and Henry his brother succeeded. Henry's son died, and he sought to secure the succession of his daughter Maud by making the barons swear fealty to her, but his efforts were in vain, and her cousin Stephen, a grandson of the Conqueror, was Henry's successor. Stephen, however, could not secure the succession of his son Eustace, and it reverted to Henry II., grandson of Henry I. and son of Maud. The next king was Richard the Lion-heart, at whose death his brother John and not his boyish nephew Arthur succeeded. There was no thought of John's succession being an usurpation at the time; this was a sentiment of after ages. And even when John died, detested by his subjects, and leaving only young children behind him, the barons, led by Pembroke, preferred to crown the eldest of these as king (Henry III.) rather than elect the Princess Eleanor, sister of Arthur, though she would have been the rightful heiress in our eyes, and was, moreover, old enough to reign. Edward I. inherited the crown of his father and grandfather, but was nevertheless elected king, he being at the time away in Palestine. When at his death he transmitted the crown to his son Edward II. the custom of the hereditary succession of the eldest son had held through three reigns, extending over a century, if we count-in the reign of John, and had become so strong that election was dispensed with. Edward III. was, however, elected on the deposition of his father. Richard II., his grandson, was on the other hand not elected, and at his coronation the archbishop expressly declared that he succeeded by hereditary right. But when Richard was deposed his successor, Henry IV., was formally elected and a fresh title to the crown conferred upon the family of Lancaster by Parliament. The inheritance devolved upon Henry "and on his heirs;" and from this time forward the succession to the crown has been as strictly hereditary as that to real property, and as strictly Parliamentary as an appointment to any other office.

Thus Parliament in 1460 tried to settle the disputed succession in the "Wars of the Roses" by limiting the title of Henry VI. to a life interest only, and declaring the Duke of York heir at the king's death. Henry was, however, deposed the same year, and as Richard had fallen in battle, Edward, his son, claimed the throne and was elected. His brother Richard III. also contrived to obtain a sort of election to cover his usurpation of the crown, and had a bill passed through Parliament entailing the crown upon his heirs (1484).

On the usurpation of Henry VII. another fresh title was made, and an entail of the crown to the new king's heirs was granted by Parliament. The succession was frequently altered by Parliament at the desire of Henry VIII., and the princesses Mary and Elizabeth were now declared heirs and now disinherited. In 1536 the king was empowered by Parliament to devise the crown by will, and he did so, naming his own children first (in the order

of their actual succession), and after them the children of his younger sister Mary, duchess of Suffolk. This would have devolved the crown upon Lady Jane Grey after the death of Queen Elizabeth, for she was the grand-daughter of the duchess. Lady Jane's friends, however, sought to bring her to the crown while Mary and Elizabeth yet lived, and the unhappy lady paid for their treason with her head. Nevertheless heirs to her claim still existed in Elizabeth's time; but these were set aside, and in opposition to the will of Henry VIII. the strict hereditary principle was enforced, and the grandson of his elder sister Margaret (Queen of Scotland) was acknowledged as heir, ascending at Elizabeth's death with the title of James I.

It was in vain that James and his son Charles preached the doctrine of divine right, Parliament still claimed the power to alter the succession. This was exercised in 1680 by the Exclusion Bill, which passed the Commons and was thrown out by the Lords, like any ordinary Parliamentary bill. James II., against whose accession (as a professed Roman Catholic) the Exclusion Bill was aimed, succeeded his brother Charles II., but was declared by Parliament to have abdicated the throne by his unconstitutional acts, and left the throne vacant. Again a fresh title was set up; and William, James' son-in-law and nephew, and his wife, James' daughter Mary, were appointed king and queen by Parliament, 1688, with remainder, failing issue, to the queen's sister Anne. A further modification (Act of Settlement, 1701) introduced the house of Hanover failing issue of Anne, and thus the present royal family succeeded.

From 1714, the date of the accession of George I., till now, the succession has been strictly hereditary, and no further interference of Parliament has been necessary. The crown of England has never before descended by regular inheritance for so long a time together, for the two-centuries-long Plantagenet line from John (ascended 1199) to Richard II. (deposed 1399) is broken by the deposition of Edward II. in 1327, though Edward III., his son, as a matter of fact succeeded. George II. succeeded his father George I. in 1727, and was succeeded by his grandson George III. in 1760. The two elder sons of George III. reigned in succession, George IV. ascending in 1820, William IV. in 1827, and as their younger brother the Duke of Kent had already died, the crown which would have been worn by him fell to his daughter VICTORIA in 1837. Like her grandfather George III., Queen Victoria had the unusual honour of being able to celebrate her Jubilee, which accordingly was done, with every accompaniment of splendid ceremonial, in 1887.

SUCCIN'IC ACID, a volatile salt of amber. This acid is found in amber, and was known as its volatile salt to Agricola in 1657. It is also found in certain lignites, in turpentine, in some plants, as in the common wild-lettuce, and in some parts of animals, as in ox spleen. It is a frequent product of the oxidation of fats, and is constantly present in small quantity among the products of the fermentation of sugar, and therefore in wines and beer. It can be obtained directly from amber by dry distillation. Succinic acid crystallizes in rhombic prisms, having the formula $C_4H_6O_4$, and is freely soluble in water, but insoluble in ether. It melts at 180° C. (356° Fahr.), and boils at 235° C. (455° Fahr.), giving off water and forming succinic anhydride ($C_4H_4O_3$). It is dibasic, forming two series of salts, neutral and acid, called succinates, and having the respective general formula of $C_4H_4M_2O_4$ and $C_4H_5MO_4$. The alkaline succinates are crystalline and soluble in water; those of the alkaline earths and metals are insoluble. These salts stand heating to 200°C. (392° Fahr.) without decomposition. Succinic acid and soluble succinates give a reddish-brown precipitate with ferric salts, which is characteristic, and succinate of ammonium, $C_4H_4(NH_4)_2O_4$, is employed in analysis for this reaction.

Succinic acid forms two derivatives with bromine, mono-bromo-succinic acid ($C_4H_5BrO_4$) and di-bromo-succinic acid ($C_4H_4Br_2O_4$); both are crystalline, and soluble in water, alcohol, and ether. It forms four crystalline ammides, succinamic acid ($C_4H_7NO_3$), succinimide ($C_4H_5NO_2$), succinamide ($C_4H_8N_2O_2$), and succinonitrile ($C_4H_4N_2$). Succinic ether, or ethylic succinate ($C_8H_{14}O_4$), is an oily body burning with a yellow flame, having a specific gravity of 1·036, and boiling at 214° C. (417° Fahr.)

SUC'CORY. See CHICORY.

SUC'CUS ENTER'ICUS, the digestive fluid of the intestines, secreted by the Brunner and Lieberkühn glands scattered along the walls of the intestine. It is very difficult to separate the succus entericus from the great variety of other secretions which the chyme contains by the time it has progressed some little way in the intestines. But after many diversified experiments it seems tolerably settled that this is a yellowish alkaline fluid with a specific gravity of 1·011, and containing about 2·5 per cent. of its bulk in solid matters. Of its two components the fluid of Brunner's glands is believed to turn proteids to peptones, and that of Lieberkühn's glands to convert starches to sugar. As a whole, the succus entericus undoubtedly turns cane sugar (common sugar) to grape sugar, and sometimes to lactic acid.

SUCKER is the name given to the species of the family of bony fishes, Gobiesocidæ, which belongs to the order Acanthopterygii. The name refers to the presence of an adhesive sucker between the ventral fins. In position this sucking disc corresponds to that found in the LUMP-SUCKERS (Discoboli), but differs in structure. In the present family the ventral fins are widely separated from each other, and only border on the sucker. The sucking disc is very large, extending for about one-third of the whole length of the body, ovate in shape, with the central portion formed only of skin. The disc is divided into two portions by a deep notch behind the ventral fins. The border of the anterior portion is formed by a membrane containing ventral rays; the posterior portion of the border is formed by cartilaginous expansions of the coracoid bones. The whole surface of the disc is covered with a thick epidermis. These singular fishes have a scaleless body and only one dorsal fin, without spines, and placed far back, opposite the anal fin. The species are numerous, found in temperate and tropical seas all over the world. They are small fishes, living near the coast. Three species are found on the southern coasts of Britain, the Cornish Sucker (*Lepidogaster gouanii*), the Connemara Sucker (*Lepidogaster candolii*), and *Lepidogaster bimaculatus*.

SUCKING, simple as it seems—for babies perform it perfectly a few moments after birth—is a somewhat complicated act in reality. It is performed principally by the depressor muscles of the hyoid bone. These, by drawing downwards and backwards the tongue and floor of the mouth produce a partial vacuum in the latter; and the weight of the atmosphere then acting on all sides tends to produce equilibrium on the inside and outside of the mouth as best it may. But as the communication between the mouth and the pharynx is shut off by the soft palate and its pillars, equilibrium can only be restored by the entrance of something through the mouth. The whole action is that of a piston in a syringe, the muscles depressing the tongue and hyoid bone answering to the power pulling the handle.

SUCKING-FISH. See REMORA.

SUCK'LING, SIR JOHN, poet and cavalier, was born in 1609 at Whitton in Middlesex, the seat of his father, who was one of the secretaries of state and comptroller of the household to James I. and Charles I. He seems to have been educated at Westminster, whence he proceeded to Trinity College, Cambridge. In 1631 he joined the force under the Marquis of Hamilton, sent to

aid Gustavus Adolphus in Germany, and is said to have earned a good military reputation. On his return home, he led the life of a fashionable wit and gallant, sprightly, generous, and dissipated. He was a favourite at court; a friend of Ben Jonson, Davenant, Falkland, &c., and considered "one of the best bowlers of his time in England." In 1637 he published his lively "Session of the Poets," the first performance of the kind; in 1638 his play of "Aglaura," which contains the well-known song "Why so pale and wan, fond lover?" and in 1639 his "Brennoralt," under the title of "The Discontented Colonel," a satire on the Scotch malcontents. He contributed in the same year a troop of one hundred horse, splendidly accoutred, to the army with which Charles marched against his Scotch subjects. This troop cost him, it is credibly asserted, no less than £12,000. In 1640 he was elected to the Long Parliament as member for Bramber, and his ardent loyalty led him to take part in the army plot of 1641. On its discovery he fled to France and died of poison by his own hand at Paris, certainly before the end of 1642. It is as a writer of songs and short poems, of which love and beauty are the themes, that Suckling is chiefly remembered. His ballad upon a wedding, and his "Siege of a female heart," are incomparable in their kind.

SUCTION PUMP. See PUMP.

SUD'BURY, a market-town and municipal borough of England, in the county of Suffolk, 16 miles south from Bury St. Edmunds, and 58 from London by the Great Eastern Railway, was formerly represented in Parliament, but was disfranchised in 1844 for bribery. It is situated on the left bank of the Stour, and connected by a bridge with the suburb of Ballingdon in Essex. It consists of several streets, which are irregularly laid out, but neatly built and cleanly kept. There are three ancient churches, which, like most similar edifices in Suffolk, are of the Perpendicular style, with square and lofty towers and handsome interiors; St. Peter's is the most interesting. The town-hall is not architecturally remarkable. An hospital, on an eminence just outside the town, was opened in 1869. The grammar-school was rebuilt in 1857, and there are several minor charities. The principal manufactures are those of silk and velvet. Straw-plaiting and hair and bristle industries are carried on. There are also some agricultural implement and lime works. Edward III. established a small colony of Flemish weavers in the town, and woollen manufactures were carried on by their descendants until within a very recent period. They have now, however, been superseded by those of silk. There are also several malt-houses, a considerable river traffic, and the neighbouring brick-works are extensive. Gainsborough the artist was born at Sudbury, and derived his early inspiration from the sweet pastoral landscapes which encircle it. The municip . borough is governed by four aldermen and twelve councillors. The population in 1881 was 6584. The present name is a corruption of Sudborgh or Southborough, to distinguish it from Northborough or Norwich, which signifies the northern city.

SUDORIF'EROUS GLANDS. See SWEAT.

SUE, MARIE-JOSEPH EUGÈNE, a famous French novelist, was born in Paris, 10th December, 1804. His father was one of the household surgeons of Napoleon I.; and the son was brought up to the same profession, acting as surgeon first in the army and afterwards in the navy. After the death of his father in 1829, the fortune he inherited enabled him to relinquish practice, and he thenceforth devoted himself to literature. He is best known in England as the author of "The Mysteries of Paris" (1842) and "The Wandering Jew" (1844–45). The former of these works appeared first in the *Journal des Débats*, and the latter in the *Constitutionnel*. In 1850 he was elected to the Legislative Assembly, as one of the deputies for the department of the Seine; but, as an ardent socialist, he was expelled from France after the *coup d'état* of 2nd December, 1852. His writings extend over many volumes. Some of his later works were suppressed as immoral and seditious by the Assize Courts of Paris. He died at Annecy, in Savoy, 3rd July, 1857.

SUESSIO'NES, the ancient Gallic tribe from whose habitat the name of the French town of Soissons is derived, were the bravest of all the Belgic or Northern Gauls, and had a standing force of 50,000 men in Cæsar's time. The rule of their king, Divitiacus, in Cæsar's time extended to the coast parts of Britain.

SUET is a variety of the fatty or adipose tissue of animals, accumulated in considerable quantity about the kidneys and the omentum or caul of several of the domestic quadrupeds. There are several kinds of it, according to the species of animal from which it is procured, such as the hart, the goat, the ox, and the sheep. When recent it is white, easily broken, translucent if thin, and almost without smell; it soon becomes rancid and yellow by exposure to the air.

Suet consists of about three-fourths of stearin, with some olein, and a little hircine and margarin. The preponderance of stearin renders it the most solid of animal fats. It liquefies with a gentle heat (103°), and the prepared suet of the Pharmacopœia is obtained by melting it over a slow fire, and straining it, to separate the membranous portion. It is used as an ingredient in cerates, plasters, and ointments. By pouring it when melted over various articles, such as potted char, from which it thoroughly excludes the air, it assists greatly in preserving them.

SUETO'NIUS, TRANQUILLUS CAIUS, the Latin historian, was born about A.D. 70. His father obtained some distinction as a soldier, and it was doubtless on information obtained from him and his comrades that much of the son's historical work had its foundation. The young Suetonius was educated for the law, and we gather from the letters of his friend, the younger Pliny, that he was successful in his profession. Between him and Pliny a close friendship existed, and several of the latter's epistles are addressed to Suetonius in the terms of cordial intimacy. Under Hadrian, Suetonius held the office of secretary or magister epistolarum, but was subsequently deprived of it by the emperor (who was of a jealous and suspicious temper) for visiting the Empress Sabina without permission. Suetonius was a voluminous writer, and two of his minor treatises, entitled "De Grammaticis Illustribus" and "De Claris Oratoribus," are still extant. By far the most important, however, of his surviving works is that known as the "Vitæ Cæsarum" (Lives of the Cæsars). It contains the biographies of the twelve first emperors, from the great Julius to Domitian inclusive. It is biographical rather than historical in its nature, and treats chiefly of the private life and character of the successive emperors. The trustworthiness of Suetonius has been much controverted, and certainly his book contains abundant evidence that he was a licentious and immoral man. This, however, does not prove him to be a dishonest writer, and we know from other sources that the state of the imperial court and of Rome itself at this period was corrupt and wicked to an extreme degree. Nor must we forget that he was contemporary with many of the later events which he describes, and must have been acquainted with many persons who remembered Augustus and Tiberius. Yet, undoubtedly, where his account differs from that of Tacitus, the authority of the latter is preferable. Like Tacitus, Suetonius hated the Christians, whom he terms "a kind of people that profess a new and malignant superstition." Among the best editions of Suetonius are those of Burmann (Amsterdam, 1736) and Wolff (Leipzig, 1807).

SUEUR, EUSTACHE LE, the celebrated French painter, the son of a turner, was born at Paris in November, 1617, and studied painting in the school of Vouet. He never visited Italy; but when the Academy of Painting in France was founded in 1648, Le Sueur had already made such progress as to be elected one of the original twelve professors or *anciens*. After various successes, he was commissioned in 1645 to paint his interesting series of twenty-two pictures illustrative of the life of St. Bruno for the Carthusian monastery of Paris; they were finished in 1648. In 1649 he painted his masterpiece, the so-called May-picture of the cathedral for that year, representing "St. Paul at Ephesus burning the proscribed books." This was given to Notre Dame by the goldsmiths' guild; it is now in the principal room at the Louvre. Le Sueur was driven from the court by the superior vogue of Le Brun; he retired to the Carthusians, and all his best work was done among the monks; he died in 1655. Though never a good colourist, Le Sueur was in many respects the best of the earlier French painters; and notwithstanding his never having visited Italy, he was a diligent student of Italian prints and pictures. Many of his works show a very successful study of Raffaelle; in expression and composition he is often very noble. His pictures are numerous, and in many of them he was aided by his three brothers—Pierre, Philippe, and Antoine. The Louvre alone contains fifty-three works by this painter.

SUEUR, HUBERT LE. See SŒUR, HUBERT LE.

SUE'VI, the ancient Germanic tribe whose name is preserved in the modern Swabia, did not originally dwell in this region; but at the close of the third century a mixed set of adventurers who seized upon that land called themselves after the once-famous name so as to give themselves the apparent standing of a tribe. The ancient Suevi were not only the most powerful body of Germans, but were as numerous as all the rest put together. They occupied the eastward countries from the Baltic to the Danube. The Suevi figure largely in ancient history as soon as the great Germanic hosts come into play. They were not so much a distinct tribe as a collection of kindred tribes, and were very migratory within their recognized boundaries, not loving towns or settlements.

SU'EZ, a town situated at the upper extremity of the gulf of the same name, 76 miles east of Cairo, has of late years acquired considerable importance as the station for steamers to India, first in connection with the overland route, as the terminus of the railway from Alexandria and Cairo, and since as the Red Sea outlet of the Suez Canal. It suffered severely in former times from want of water, which was brought by steamers from Aden and from other distant places, but which is now supplied by a fresh-water canal from the Nile passing by Ismailia and to the right of the ship canal. It has a good harbour and roadstead, a considerable trade in coffee, dried fruits, and other commodities, and extensive docks, European offices, and warehouses. The population is about 15,000.

SU'EZ CANAL. See CANAL.

SU'EZ, GULF OF, the north-west arm of the Red Sea, extending from the southern extremity of the peninsula of Mount Sinai to the town of Suez, about 180 miles long, with an average breadth of 20 miles.

SU'EZ, ISTHMUS OF, a neck of land connecting Africa with Asia, and lying between the Red Sea and the Mediterranean. It is 70 miles wide, and consists of level sandy tracts, with salt lakes, and some rocky bosses of shell-limestone rising through the sand. The ranges east of the Nile, on whose terminal slopes part of Cairo stands, sweep round east and south-east, bounding the isthmus on that side, while on the north-east the ground gradually rises toward the high plateaus of the Sinai Desert; but the maritime portion, towards El Arish and the river of Egypt, is continuous with the western plain of Palestine, on the Mediterranean coast. The railway from Alexandria is continued by two lines through Zagazig and Cairo to Ismailia at the centre and Suez at the southern mouth of the ship canal, across the northern part of the Arabian desert. Traces of the old canal begun by Pharaoh-Necho, and completed under the Ptolemies, still exist.

SUFEID-KOH or **WHITE MOUNTAINS** is a high range, bounding the valley of the Cabul River on the south, and about 100 miles south of the Hindu-Kush, limiting the valley north. It extends from near Attock, 72° 16′ lon., on the parallel of 34° to 69° 30′ lon. The chain is wholly primary; it consists of three parallel ranges, of which the southern or inner is highest, reaching 15,622 feet, and is covered with perpetual snow. It is connected on the west with the Gul-kuh, on the south-west with Cabul, an offset of the Hindu-Kush, and on the east with the salt range. The east part is called the Khyber range.

SUFFICIENT REASON, DOCTRINE OF THE, in mathematics and physics. The principle which is connected with these words might be, and frequently is, called the want of sufficient reason; and even this term may appear inaccurate, for it should be the want of any possible amount of reason. Since, however, all that takes place must have a sufficient reason (whether we know it or not) for its happening, and everything which is asserted must be capable, if true, of being shown to have a sufficient reason, there is no objection to our using the words "want of sufficient reason" in the sense of absolute want of reason in all matters connected with the exact sciences. If A be equal to B there must not only be reason but reason enough for it; anything short of reason enough is no reason at all, and anything short of proof enough is no proof at all.

The use of the word reason in the statement of this principle may itself be fairly objected to. We are in the habit of speaking of mathematical consequences in the same manner as of those to which the notion of cause and effect applies. This is, however, wrong as applied to mathematical propositions, because when any one is made to prove a second, it generally happens that the second, when granted, may be made to prove the first. Now it is absurd to say that of two things each is the previous cause of the other. The whole of this confusion may be remedied by any one who will remember that one proposition is not the cause of another; but it is our perception of the one which is made the instrument of bringing about our perception of the other. To say that B is the consequence of A is only to say that our knowledge of the truth of B is the consequence of our knowledge of that of A.

Taking care to use the word reason in the sense just alluded to, we assume that whatever is necessary has a possibility of being shown to be necessary, and that whatever is true has a possibility of being shown to be true. If this be a legitimate assumption it then follows that whatever it is impossible to show to be true must be false. But can there be such a thing as a proposition of which there shall be seen, not its falsehood, but the impossibility of demonstrating its truth? Can there arise a case in which we shall be so completely cognizant of all that may possibly be said for or against an assertion as to affirm a necessary incapability of demonstration of one side or the other? Such cases are universally admitted by mathematicians to exist; and the final assertion which is made on the known impossibility of proving a contradiction is said to be made on the principle of the want of sufficient reason. In the isosceles triangle there is a want of sufficient reason, that is, a want of any possible reason, why the angles at the base should be unequal, which might be, were it needful, safely allowed to introduce the assumption of their equality. In statics, when two equal weights are placed on a straight lever, at equal distances from the fulcrum, there is a want of sufficient reason, or a

want of any imaginable reason, why either of them should descend rather than the other; and this, in the original system of Archimedes, is the ground of the assumption that they will balance one another.

SUF'FIX. Suffixes are those syllables which, added to a root, give an inflexion to a word or create a new word. Suffixes were once independent words, but by constantly being added to roots to modify their meaning they have lost their own independent value, and have become mere signs of relation and formative elements. Thus the *ly* in sure*ly* is simply a worn form of *like*, and was formerly written in full, and bore an unchanged meaning.

Many words have lost a suffix they once had; for instance wolf represents Latin lup *us*, hound represents Gothic hund-*s*, Latin can-*is*. Door was in Old English dur-*u*, knee was in Gothic kni-*u*.

I. Of suffixes of Teutonic origin forming nouns we get the following classes: OW, as shad-*ow*; EW. as sin-*ew*; Y (formerly IG), as bus-*y*, hungr-*y*. Our adjectives are largely made from this last, as earth-*y*, wood-*y*, &c. These are vowel suffixes; consonants give us the following:—Diminutives, OCK, as bull-*ock*, mil-*k*, Wile-*ock* (a name); KIN, as lamb-*kin*, Wil-*kins*; ING, as k-*ing* (cyn-*ing*), whit-*ing*, and all our present participles; LING, as dar-*ling*; Y or IE for ING, as Will-*y*, lass-*ie*; ISH, as Engl-*ish*, green-*ish*; L, R, for EL, ER, as brid-*le*, fow-*l*, litt-*le*, hamm-*er*, bitt-*er*; M, as bloss-*om*, ar-*m*; N, as beat-*en* and other past participles, bair-*n*, cor-*n*, maid *en*, flax *en*, and many adjectives; e'e-*n* is for *ud*; L, as ax-*le*, buria-*l* (where the *l* is for *ls*, the old form being *byrgels*), ridd-*le* (*rædels*), &c.; NESS, as good-*ness*, and as a second suffix after Romance particles, joy-*ous-ness*, both large sources of words; EST, as harv-*est*; STER, as bol-*ster*, spin-*ster*; D and TH, as love-*d* and other past participles, horn-*ed* and other adjectives, bol-*d*, &c., sigh-*t*, tru-*th*; THER, as an agent, in bro-*ther*, sis *ter*, and as an instrument, in wea-*ther*, fod-*der*, and as a sign of comparison, in fur-*ther*; ER, as bak-*er*, mill-*er*, sometimes with an *i*, as cloth-*ier*.

Some suffixes retain much of their original independence of meaning, and are almost able to be treated as compound with their roots. Such words, of which the following are types, are from each class: priest-*craft*, man-*kind*, king-*dom*, wel-*fare*, cow-*ard*, man-*hood*, hat-*red*, bishop-*ric*, lord-*ship*, wheel-*wright*, coster-*monger*. Adjectives of this class are stead-*fast*, mani-*fold*, hate-*ful*, fear *less*, god-*ly*, blithe-*some*, twen-*ty*, fro-*ward*. Adverbs give the following classes, on-*ly*, dark-*ling*, head-*long*, piece-*meal*, back-*wards*, no-*wise*.

Others are much disguised in their present form, as bar-*n* for bereaern (*i.e.* barley-house), brid-*al* for bridale, huss-*y* for house-wife, ici-*cle* for is-gicel (*i.e.* ice-jag), nos-*tril* for nose-thyrel (*i.e.* nose-hole), or-*chard* for ort-yard (*i.e.* herb-garden), *r-rup* for stig-rap (*i.e.* climb-rope), or rope by which one climbs to the saddle, tad-*pole* for tad-pool (*i.e.* frog or toad in the pool).

II. The next great division is the vowel suffixes of Romance origin. And here also some suffixes have been lost, as beast for best-*e*, Lat. best-*ia*; vein for veyn-e, Lat. ven-*a*; fig for fyg-e, Lat. fic-*us*.

A large number of words are made with Y, representing IE of the French and IA of the Latin. Thus we get the classes shown by cop-*y*, fol-*ly*, bak-*er-y*, Ital-*y*, melod-*y*; or it represents Latin IUM, and we have augur-*y*, stud-*y*, and the like; or it stands for Latin ATUS, whence deput-*y*, all-*y*, &c.; CY, SY stand either for French *cie*, Latin *tia*, or as equivalent to *ateness*, thus chaplain-*cy*, minstrel-*sy*, degener-*acy* (degener-*ateness*), &c.; but sometimes these are the Greek SIS, as epilep-*sy* (epilepsis), &c. *Ancy*, *ency*, *mony*, *ary*, *ee*, *ey* will be spoken of later. Beyond the various *y*-suffixes there are no more Romance vowel-endings.

In endings of Romance origin several words have lost their consonantal suffixes. Such are jolly for jol-*if*, testy for test-*if*, hasty for hast-*if*.

The Latin *rus* becomes *re* or *fe*, as octa-*re*, sa-*fe*; and the Latin *tivus* or *ivus* becomes *ive* or *iff*, as capt-*ive*, bail-*iff*. OUS and ESE stand for Latin *us*, *osus* (Fr. *eux*), and *ensis* (Fr. *ais*), as anx-*ious*, fam-*ous*, Chin-*ese*; and ESS is the Latin *issa* (Fr. *esse*), and forms a large part of English plurals feminine, as count-*ess*, host-*ess*.

R stands for Latin *rus*, *ris*, or (Fr. *eur*), and *arius*, also denoted by ARY, EER, &c., as clea-*r*, pu-*re*, famili-*ar*, flow-*er*, hon-*our*, contr-*ary*, engin-*eer*, carpent-*er*. ARY, RY, &c., also represent Latin *arium*, *aria*, and French *rie*, as gran-*ary*, caval-*ry*, cook-*ery*, poult-*ry*.

The L suffixes are also a numerous class. Temp-*le* is for Latin *-lum*, ang-*le* for Latin *-ulus*, can-*al* for Latin *-ula*, cand-*le* for Latin *-ela*, met-*al* for Latin *-allum*, fa-*ble* for Latin *-bulus*, specta-*cle* for Latin *-culum*, equ-*al* for Latin *-alis*, gent-*eel* for Latin *-ilis*, accepta-*ble* for Latin *-bilis*.

Of M suffixes fu-*me* is for Latin *-mus*, fa-*me* for Latin *-ma*, rais-*in* for Latin *-emus* (rac-*emus*), char-*m* for Latin *-men*, leav-*en* for Latin lev-*amen*, nou-*n* for Latin no-*men*, emble-*m* for Greek *-ma*. ISM, a fairly large class, is for Greek *ismos*, Latin *ismus*, as bapt-*ism*, vulgar-*ism*. Latin *umnus* becomes *mn* in autu-*mn*, &c., and Latin *monia* or French *moine* is our MONY in cere-*mony*, &c. MENT is Latin *mentum*, French *ment*, as instru-*ment*, gar *ment*, &c.

N stands for Latin *anus*, *enus*, *inus*, as Rom-*an*, ple-*ne*, citiz-*en*, ali-*en*, cous-*in*, lecter-*n* (Fr. lutr-*in*), doctr-*ine*, &c.; for Latin *o* or *io* (accusative *onem*), as falc-*on*, compan-*ion*, &c.; for Latin *aneus*, as mount-*ain*, carr-*ion*; and for Latin *erna*, *urnus*, as cav-*ern*, noct-*urn al*.

The C suffixes represent Latin *ax*, &c., as furn-*ace*; Latin *acus*, as mani-*ac*; Latin *icus*, as arithmet-*ic*; Latin *ucus*, as lett-*uce*; Latin *aceus*, &c., as men-*ace*, cut-*lass*; Latin *iscus*, as grot-*esque*; Latin *aticus*, as fan-*atic*; Latin *aticum*, as langu-*age*.

The large family of T and D suffixes stand for the Latin terminations in *tus*, *tum*, &c., as *atus*, *itus*, &c., *idus*, &c., as advoc-*ate*, lega-*tee*, favour-*ite*, modes-*t*, ac-*id*, conques-*t* (*-tum*), aun-*t* (*-ta*)—but *ta* has become *y* in assembl-*y*, chimne-*y*—brig-*ade*, banqu-*et*, &c. ET has a large diminutive class, derived from French *ett*, *ette*, as coron-*et*, cask-*et*, brace-*let*. TY is the French *té*, Latin *tas*, as beau-*ty*, &c. Ar-*t*, foun-*t*, &c., represent the *t* which occurs in the genitive of many Latin nouns, as *ars*, *artis*; *fons*, *fontis*, &c. Mas-*ter*, doc-*tor*, corri-*dor*, succes-*sor*, represent like Latin endings, but this suffix is often softened, as emper-*or* for imper-*ator*, compi-*ler* for compil-*ator*, preach-*er* for predic-*ator*, &c. Apost-*ate*, com-*et*, &c., come from the Greek nouns in *tês*; bapt-*ist*, art-*ist*, from the Greek *istês*, French *iste*. Chor-*ister*, administr-*atrix* (observe nur-*se* for nu-*trix*), crea-*ture*, are Latin terminations. TORY stands for Latin *torius*, as dormi-*tory*, so also minis-*try*, for Latin *-terium*. NT, a very large class, is for Latin *ns*, *ntis*, as elega-*nt*; so also leg-*end* for Latin leg-*endum*, corpu-*lent* for Latin *-lentum*, abund-*ance* for Latin *-antia*, excell-*ence* for Latin *-entia*, ac-*tion* for Latin *-tio*, &c.

Many verbs are coined with the Greek suffix *izô*, French *iser*, as apolog-*ize*, surpr-*ise*. The Latin inchoative suffix *escere* gives our verbal *ish*, as admon-*ish*, fin-*ish*; and the Latin *ficare* is our *fy*, as edi-*fy*, signi-*fy*, &c.

SUF'FIX, in mathematics, a term lately employed in mathematical language to denote the indices which are written under letters, as in a_0, a_1, a_2, a_3, &c. The distinctive name was first used by Professor Hall in his "Differential Calculus."

SUF'FOLK (*i.e.* country of the South Folk), a maritime county of England, is bounded on the N. by Norfolk, E. by the North Sea, W. by Cambridgeshire, and S. by Essex. Its greatest length from east to west is about 60 miles; its greatest breadth from north to south, 40 miles. Its superficial area is 1484 square miles, or 949,825 acres. The population in 1881 was 356,863.

Surface and Coast-line.—The surface of Suffolk is gently undulating, except along the north-western and some parts of the north-eastern border, where it subsides into low marshy levels, only protected from inundation by artificial embankments. The landscapes here, though of a monotonous, are not of an uninteresting character. The flat is often relieved by a tranquil village clustering round the low gray tower of its ancient church. Through the rich meadows steals the glittering water-course, and an occasional clump of leafy trees affords a breadth of pleasant shadow. In winter the whole district is haunted by millions of wild fowl, but the rapid progress of extensive systems of drainage will soon drive them away, and convert these steaming fens into firm and valuable dry land. Inland, the county wears a truly pastoral aspect. The rich grassy leas are dotted with herds of cattle and flocks of sheep, and large tracts are sown with crops of corn.

The coast-line, which is about 50 miles in length, is remarkably regular, being broken by no important indentation, nor interrupted by any considerable headland, except Lowestoft Ness, the easternmost point of Great Britain. The bays are shallow, and the only one worth notice is that of Southwold or Solebay, where, during the first three days of June, 1666, occurred a desperate engagement between the English and Dutch fleets, in which neither side could claim a decisive victory. The cliffs here are very low and barren; the soil sandy, and brightened only by masses of bracken and heath. The cliffs extend from hence, with few exceptions, to the mouth of the Yare. There is a small headland, at the mouth of the estuary of the Orwell and the Stour, crowned by Landguard Fort. A little to the northward projects Felixstow Point, where the cliff is much worn by the sea, and presents a curious variety of colour; reddish-yellow at the top, darkening as it descends into brown and black, with horizontal streaks of buff and yellow. Fossil shells and coprolites have been discovered here in large quantities. The coast-line of Suffolk is remarkable at various points for the rapid manner in which the sea undermines the cliffs.

The harbours are formed by the estuaries of the rivers Stour and Orwell, between Harwich and Landguard Fort; the Deben, below Woodbridge; the Alde, at Orford; the Blythe, near Southwold; and the artificial cut through Lake Lothing into the Waveney, at Lowestoft.

The shores of the Orwell estuary are lined with marshes, which extend about 500 yards inland, and then give place to "broad meadows that rise with green slopes to th wooded uplands at their rear." The same description may be applied to the banks of all the Suffolk rivers where they approach the sea.

Geology.—The greater part of the county is covered by diluvial beds. The exceptions are the Crag and London clay district of the south-east, and the chalk district of the north-west; the former extending from Orford, by Woodbridge and Ipswich, to the banks of the Stour, below Sudbury; the latter stretching north-west and west by south from Bury St. Edmunds. The Crag formation chiefly consists of thin layers of quartzose sand and comminuted shells, resting sometimes on chalk and sometimes on the London clay. There are scarcely any minerals of value in the county. Chalk and shell-marl from the Crag formation, and coprolites on the coast, are used extensively for manure.

Rivers.—The Waveney and the little Ouse are border rivers, separating this county from NORFOLK under which head they will be found described. The Waveney enters the sea by the estuary of the Yare at Yarmouth, but is also connected with it at Lowestoft by a cutting which traverses the small sheets of water known as Oulton Broad and Lake Lothing, and which has recently been reopened for navigation. The scenery along the river is often very pleasant. A popular writer and observant traveller thus describes "the Broad" and the country round Beccles:—"The Broad is a crescent-formed sheet of water, communicating with the Waveney at its upper end by a narrow channel, called Lyke Dick (or Dyke). The Waveney, though very winding, is broad and deep, and open to the tide, which sends up a great volume of water, felt as far as Shipmeadow Lock, above Beccles. Its name is said to be derived from the Saxon *wafiend ee* (waving water); and if waving may imply crookedness, the name is markedly descriptive; for the stream winds continually between the two counties; now through broad meadows, where the banks are firm and cattle numerous; now past rushy flats and draining mills, low knolls, slopes of heath, and patches of fir."

Breydon Water, above 3 miles long and 1 wide, lies just below the junction of the Waveney and the Yare, on the north-eastern border of the county.

The Larke, a tributary of the Greater Ouse, has its source about 6 miles south of Bury St. Edmunds, flows north to that ancient town, and then north-west by Mildenhall to the Norfolk border, which it skirts for a few miles previously to entering Cambridgeshire. Total length, about 30 miles. It is navigable from Bury, and maintains a communication between that town, the Ouse, and the port of Lynn.

Of the streams which drain the southern division, the most important is the Stour. It divides Suffolk from Essex, and is noticed in the article relating to the latter county. Its tributaries are all unimportant.

The Orwell, or, as it is called in the upper part of its course, the Gipping, is formed by the junction of several streams near Stowmarket. Thence it flows south-east, by Needham Market, to Ipswich, 20 miles, being navigable throughout; from Ipswich to Landguard Fort the estuary extends about 12 miles, with an average width of 900 to 1000 yards at high water.

The Deben rises near Debenham, and flows some 20 or 22 miles in a winding course to Woodbridge, where it forms a bay or estuary, locally known as Woodbridge Haven, 9 or 10 miles in length, and nearly half a mile in width, navigable for sea-borne vessels of considerable burden. The district between the estuaries of the Deben and Orwell has been celebrated by Bernard Barton as a fitting locality for a beautiful abiding-place:—

> "On that shore, where the waters of Orwell and Deben
> Join the dark heaving ocean, that spot may be found;
> A scene which recalls the lost beauties of Eden,
> And which Fancy might hail as her own fairy ground."

Near the village of Brundish rises the little river Alde, which, after a course of 11 miles, joins the Ore. The latter has its source near Framlingham, and an eastward career of about 12 miles. The united stream forms a broad estuary, 15 miles long. When at Aldborough it has approached within 200 yards of the sea, it turns suddenly at a right angle, strikes southward, and flows parallel to the sea, from which it is separated only by a narrow tract of marshy land, for 10 miles. This divergence is owing to the choking up of its ancient mouth. The new channel has been cut through the Vale of Slaughden.

The principal feeder of the Alde is the Butley, a small stream, whose lower course forms a tolerably wide estuary, opening into the estuary of the Alde below Orford. The Alde is navigable to Snape Bridge, near the head of the tideway. The portion below the junction of the Butley is sometimes called Butley.

The Blythe rises near Laxfield, and after an easterly course of 16 miles, 9 of which are navigable, falls into the sea.

Railways.—Suffolk is included in the system of the Great Eastern Railway, which enters the county near Brandon, and strikes across it to Ipswich, Beccles, Lowestoft, and Great Yarmouth. There are branches to Framlingham and Aldborough. From Ipswich the main line runs north towards Norwich, and north-west to Bury St. Edmunds and Newmarket. A short line connects Ipswich with Hadleigh.

Agriculture.—Suffolk, with the adjoining counties of Norfolk and Essex, forms one of the best cultivated districts in the southern part of Great Britain. The climate is much drier than that of the more western counties of England; but also colder in spring, when the north-easterly winds prevail. The soil, although varying extremely, may be divided into three or four distinct kinds. A very rich loam, chiefly alluvial, is found in a small portion of the southern part of the county between the Orwell and the Stour. This loam is not so compact as clay, nor so loose as sand, but contains a great proportion of organic matter. The next class is composed of heavier loams, varying in every degree, but in general resting on an impervious soil of marl or clay, and in most situations requiring the assistance of drains to carry off superfluous water. This is found in the whole of the centre of the county, from the Stour to the borders of Norfolk, and is computed as being nearly half the whole superficial area. Between the strong loam and the sea a strip runs from the north bank of the river Orwell to Yarmouth, diminishing in breadth as it stretches northward, and consisting chiefly of sand of various qualities, incumbent on a subsoil of crag, namely, a loose rocky substance, composed of sand, gravel, and broken shells, and partly consolidated into stone. Some of this sand is poor, but a great part of it is enriched by organic matter intimately mixed with it, and is admirably adapted for roots, especially carrots, and bears very fine barley. In the portions which lie low, and which have at some time or other been covered with water, a very rich mud has been deposited, which has produced as rich a soil as could be desired. These rich oases, however, are few in comparison to the whole tract, which altogether contains about 150,000 acres. Another district of a much inferior quality lies on the western extremity of the county, extending from Bury St. Edmunds to Thetford, with some better lands interspersed. It occupies chiefly a chalk bottom, and is scarcely worth cultivating. Where improved, so as to become productive, it has been done at a very considerable expense in draining, trenching, and marling. The last class consists of the fen-lands, which, when properly drained, become very valuable, but in their natural state are necessarily unproductive.

The system of tillage is very uniform throughout the county. The greater part of the land is under the plough. There is now scarcely such a thing to be seen as a common field. The practice of ploughing the stubble immediately after harvest, and giving it the full benefit of the alternations of rain and frost which mark the variable climate of Great Britain, is adopted in all kinds of soil. Wherever turnips can be profitably raised, and safely fed off with sheep, they form the basis of all rotations. Where the land is too strong and adhesive for them, where sheep would do harm by their treading, and where the carts and horses would do equal damage in taking them off, a fallow is substituted. On turnip land the four-course shift, as it is called, is universal, with some deviation as to the recurrence of clover every fourth year, a portion of the land being laid down with grass seeds, or planted with beans or pease, according to the nature of the soil.

There is no part of England where the implements of husbandry are more perfect than in Suffolk, or where new implements are tried with more readiness and with less prejudice. Nowhere is a greater variety of farm machines used for saving labour.

There is only one kind of cattle which is peculiar to the county. It is a polled breed, of which the cows are justly in great repute. They are usually of a light red, sometimes spotted with white, of moderate size, and excellent milkers, giving on an average 4 gallons per day. The Suffolk farm horses, called *punches*, are noted for their docility, steadiness, and unwearied perseverance against a dead pull. The pigs are perhaps, on the whole, the most profitable breed in England. They are well-shaped, short-legged, mostly white, with short upright ears, and the porkers are excellent. There is no indigenous breed of sheep; a cross of the Southdown with the Leicester and Cotswold is very common.

Manufactures.—Suffolk was formerly celebrated for its manufactures, particularly those of wool, but they are now much decayed. Mixed silks and worsted stuffs are still, however, manufactured at Sudbury and other places, and agricultural implements and machinery are made on a large scale at Ipswich, Stowmarket, and Bury St. Edmunds. Other industrial occupations are the manufacture of flax, horse-hair seating, paper and gun-cotton, straw-plait, malt, bricks, whiting, and artificial manures. There are also upwards of 2000 persons engaged in the straw-plait manufacture in different parts of the county.

Divisions.—Suffolk is divided into twenty-one hundreds. It is chiefly in the diocese of Norwich, but a portion is included in that of Ely. It is in the Norfolk circuit, and the assizes are held in Lent at Ipswich, and in summer at Bury St. Edmunds. For parliamentary purposes it is divided into five divisions, each of which returns one member. The borough of Ipswich returns two and Bury St. Edmunds one—making a total of eight representatives for the whole county. IPSWICH is the county town.

History and Antiquities.—Suffolk appears to have been comprehended with Norfolk in the territories of the Simeni of Ptolemy, called by others the Iceni. It was included in the Roman province of Flavia Cæsariensis. There were several British and Roman towns in this county. The river Waveney and its valley appear, in the British and Roman periods, to have formed one of the branches of a great estuary which penetrated deeply into the interior on this side of the island, and ascended at least as far as Bungay; it probably continued even further inland, for traces of ancient navigation have been noticed as far up as Eye. Several lines of Roman roads extended through the county, such as the Peddar Way and the IKENILD STREET.

Roman antiquities have been found at Burgh Castle, near Breydon Water, where the greater part of the walls of a Roman encampment are yet standing, the whole length of rampart being 428 yards, the height 14 feet, and the thickness 9 feet; at Blythburgh, at Bury, at Dunwich, at Eye; at Haughley, near Stowmarket, where a Norman castle was erected on the site of a Roman camp; at Icklingham, near Mildenhall; at Ickworth, near Bury; at Ixning or Exning, near Newmarket; at Ixworth; at Pakenham, near Ixworth; at Stow Langtoft, in the same neighbourhood, where are the remains of a military post; at Felixstow, near the mouth of the Deben; and at Wenham, near Stratford.

Suffolk was probably settled by a body of Angles independent of those who occupied Norfolk. The names of South Folk and North Folk describe the relative position of these two tribes. In the civil war of Stephen and Henry of Anjou, afterwards Henry II., Ipswich, which was held by Hugh Bigod for Henry, was captured by Stephen (1153).

In the middle ages the county appears to have abounded with religious establishments. Tanner, in his "Notitia

Monastica," enumerates fifty abbeys, priories, hospitals, or colleges. Only three, however, of the greater monasteries, or those with £200 clear yearly revenue, were in the county, the abbeys of St. Edmundsbury, Sibton, and Butley. Of Butley Abbey, between Woodbridge and Orford, the gate-house is the principal memorial; it is incorporated in a modern mansion; there are some other remains of the abbey, but of less moment. Of Sibton Abbey, which is near Yoxford, on the road from Ipswich to Yarmouth, the ruins are both interesting and extensive. Of castellated remains the most remarkable are Framlingham, Orford, Clare, Bungay, Mettingham, and Wingfield. Of old mansion houses, with which the county abounds, Flixton Hall, near Bungay; Giffard's Hall, at Stoke by Neyland, on the Stour; Helmingham Hall, near Debenham; Hengrave Hall, north-west of Bury; Kentwell Hall and Melford Hall, near Sudbury; and Parham Hall, near Framlingham, may be mentioned.

SUFFOLK (CHARLES BRANDON), DUKE OF, was the son of Sir William Brandon, who carried the standard of the Earl of Richmond (afterwards Henry VII.) at the battle of Bosworth, and was slain by Richard III. himself. Young Brandon became a ward of the crown, grew up with the king's children, and was the playmate of his future sovereign and bride. Prince Henry, as he advanced in years, seems to have grown in attachment to his friend, and on ascending the throne appointed him one of his esquires and chamberlain of the principality of Wales. In 1513 Brandon took part in a desperate conflict with a French squadron off Brest, and on his return was created a peer by the title of Viscount Lisle. Shortly after, he accompanied the king in the invasion of France, and was present at the capture of Thérouenne and the battle of Spires, in which he commanded the vanguard of the English army. He was next created Duke of Suffolk. Meanwhile the Princess Mary had been married to the old French king, Louis XII., who witnessed from a couch the gallant exploits of Brandon at the tournaments. Louis died in less than three months (1st January, 1515), and his young and beautiful widow resolved to reward herself for her former sacrifice, and in less than two months privately married her old playmate and first love. Henry VIII. at first made a show of resentment, but he soon forgave his sister and his friend, and they were publicly wedded at Greenwich, the duke receiving at the same time from the king a grant of the great estates which had formerly belonged to Edmund de la Pole, earl of Suffolk, and an immense dowry with his wife. Brandon was present at the famous interview of the Cloth of Gold in 1519. Three years later he invaded France at the head of 12,000 men, and penetrated within 11 leagues of Paris, but was obliged to make a hasty retreat owing to the want of provisions. The duke readily gave his support to all the measures which led to the Reformation, and was rewarded with large grants of abbey lands. In 1536 he commanded the troops sent against the insurgents of Lincolnshire and Yorkshire in the pilgrimage of Grace; and in 1544 once more accompanied the king to France, and besieged and reduced Boulogne. He died in 1545, and was interred with great magnificence in St. George's Chapel, Windsor. Charles Brandon was brave, handsome, and accomplished, and though an honest and upright man he retained the favour of his imperious sovereign to the last. In his final will Henry VIII. directed that his own children should reign (failing heirs to either of them) in this order, Edward, Mary, Elizabeth, and that the crown should then go to the children of his sister, the Duchess of Suffolk. Mary's daughter Frances married the Marquis of Dorset, and was the mother of Lady Jane Grey.

SU'FISM (derived by some from Gr. *sophos*, a sage, and by others from Arab. *sof*, wool, in allusion to the woollen robes worn by the dervishes), a term of uncertain origin, used to designate a system of religious thought and practice which arose about the ninth century within Mohammedanism. Its adherents, termed Sûfis, form a kind of ecclesiastical order, which is divided into numerous distinct classes of dervishes or fakirs. As narrated under MOHAMMEDANISM, one of the first conquests of the Arabs was that of Persia, the inhabitants of which were compelled by the point of the sword to accept the new faith. More civilized than their conquerors, however, they soon made their influence felt both in political and ecclesiastical affairs, for in respect to the former, even under the first dynasty of Caliphs, the government was virtually conducted by Persians and Greeks, while with regard to the latter, after the first great schism and the division of the new religionists into Shiahs and Sunnis, sect after sect boldly arose in Persia, reproducing the old Magian ideas under a thin veil of Islam. In this way a place was found in Mohammedanism for that Oriental mysticism which has flourished for ages in the East, and which underlies the whole body of Shiah doctrines. In the system of Sufism the main principle is that there is no real existence except that of God, and that all the phenomena of the material universe are but emanations from Him, and tend ultimately to reabsorption in Him. The creation of the human soul is ascribed to Divine desire for recognition, but as the soul, like everything else, is a mere emanation from God, and as God is the only source of perfect being, the remoter it is from that source the further it is from perfection. To rejoin that source, then, is the highest ideal of man, and to lead man to the attainment of this ideal is the aim and object of Sufi doctrine. The doctrine itself is spoken of as a road (*sarikat*), the disciple is a traveller (*sálik*), and the various stages of spiritual development are called stations (*manázel*). The first stage, which may be taken by all true believers, implies merely a strict obedience to all the ritual laws and ethical principles of Mohammedanism. The second station is reached by those who rise to the conception of the truth and spiritual beauty underlying the commandments, and who obey from love and with delight. The third station, reached only by a few, is that in which contemplation and devotion have resulted in a perception of the true nature of God, and of the power to commune with him; while the highest state of all implies such direct and constant communion with God, that personality is lost, and the invisible God becomes manifest in man. Sufism has been the source of inspiration to nearly all the poetry of Mohammedan Persia, India, and Turkey, and it has included within its ranks some of the greatest poets, philosophers, historians, and saints of the Mohammedan system. Apart from its doctrines, the features of the system which assume the greatest prominence are: (1) the indifference of its votaries to the outward forms of religion, and (2) the practices of asceticism by which it has sought to attain communion with God. With respect to the former, to the true Sufi who has set out on the mystic journey, most of the outward forms of religion become matters of indifference, and he even delights in describing his devotions by terms which express things forbidden in the exoteric law. More especially as religion is identified with love, does he delight in the use of erotic expressions to illustrate the relation of man to God, and as the soul approaches nearest to God when in a state of ecstasy, he uses the symbol of intoxication with wine to represent ecstatic contemplation. The most popular, if not the most technical, exponent of the doctrines of Sufism is the great Persian poet Hafiz, who, like his fellows, depicts the aspirations of the soul, the ecstatic state, and glory of union under the similitudes of sexual love, revelling and intoxication, though, as we have noticed in his life, there is good reason to suppose that he made himself personally and thoroughly acquainted with the earthly conditions he uses for his symbols. If we accept, in common with all devout commentators, the

mystic meaning of his lyrics, it must be admitted that no other Oriental poet has so enthusiastically described these material pleasures, while at the same time striving to raise his readers to the contemplation of his ideal of the eternal and divine love prevading the universe. As an illustration we append a few lines translated by Emerson from the poem of Hafiz entitled "Ghaselle."

> "O just fakir, with brow austere,
> Forbid me not the vine;
> On the first day, poor Hafiz' clay
> Was kneaded up with wine.
>
> "He is no dervise, Heaven slights his service,
> Who shall refuse
> There in the banquet to pawn his blanket
> For Shiraz' juice.
>
> "Who his friend's shirt, or hem of his skirt
> Shall spare to pledge;
> To him Eden's bliss and angel's kiss
> Shall want their edge.
>
> "Up! Hafiz, grace from high God's face
> Beams on thee pure;
> Shy thou not hell, and trust thou well,
> Heaven is secure."

Omar Khayyam is even more outspoken in his indifference to the outward forms of religion, as the following remarkable lines will show:—

> "Kaabeh or Josshouse—'tis his house of prayer;
> E'en jangling bells invite us to his shrine;
> Mosque or cathedral—he is present there;
> Crescent or crucifix, 'tis Allah's sign."

Several illustrations of the erotic songs used by the dervishes in their devotions will be found in Lane's "Modern Egyptians," and it may be stated generally that in such productions "wine" signifies devotion; "revel," religious ardour; "the wine house," a state of ecstasy; "sleep," devout meditation; "kisses," raptures of piety; "perfumes," religious hopes; "beauty," the divine perfections; "the lips of the beloved one," divine mysteries; "tresses of beautiful hair," divine glories, &c.

With respect to the practices of asceticism, by means of which the devotees of Sufism seek to attain communion with God, they resemble those adopted by mystics in all ages and countries, and include solitude, contemplation, abstinence, the fervour induced by physical exercise, music, vocal and instrumental, and the contagious excitement produced when numbers engage in emotional worship. Many of the practices of the modern dervishes and the beliefs associated with them may be traced back to sources much older than Mohammedanism, and they may be readily identified with similar practices and ideas described in the Old Testament in connection with the religious observances of early Israel. Probably their true origin must be looked for in that primitive Eastern cult which preceded even the ancient systems of Brahmanism and Zoroastrianism, and from which they, with other systems, have sprung. To the student of comparative theology, the history of Sufism is interesting for many reasons, and among others for the curious parallels which may be traced between the experiences recorded in the annals of the various Sufi orders with their saints and devotees, and the lives and visions of the mystics and saints of Christianity.

In its highest aspect, Sufism may be regarded as the outcome of profound thought and earnest devotion, influenced by the mystic lore of ancient and now obsolete Eastern religions; but it has another side, for in the practices of the dervishes and fakirs it displays rites of a savage character, and the assumption of miraculous powers, sustained chiefly by imposture.

SUFFRAGAN BISHOP. See BISHOP.

SUGAR (Fr. *sucre*, Ger. *zucker*, Lat. *saccharum*, but the word seems to come more directly from the Persian ***shukkur***, which is nearly the same as the English pronunciation), a sweet granulated substance, too well known to require any particular description, is everywhere in extensive use, and in this country ranks rather among the indispensable necessaries of life than among luxuries. In point of commercial importance it is second to very few articles. It is chiefly prepared from the expressed juice of the *Arunda saccharifera*, or sugar-cane; but it is also procured from an immense variety of other plants, as beet-root, maple, birch, parsnips, &c.

History.—There is little difficulty in believing the scriptural writers to be the earliest who allude to sugar. Persons in frequent communication with the East were sure to have obtained its products before the Greeks. Herodotos refers to manufactured honey, supposed to mean sugar; and Strabo mentions that Nearchos, one of Alexander's admirals, speaks of a reed in India which yields honey without bees. Theophrastos describes it as a honey obtained from a reed which grew in moist places in Egypt, and had a sweet root. Eratosthenês alludes to roots in India sweet to the taste, even when boiled, as if it were the custom to boil them to remove the sugar. Varro speaks of the juice of an Indian root so sweet that, when pressed out, no honey can contend with it. Sugar was brought to England from Sicily and Egypt in the twelfth century. In the year 1166 a mill for grinding sugar-canes was set up at the monastery of St. Bennet. The cane afterwards got into Valencia, and thence to Granada and Murcia. About 1420 the Portuguese imported it to Madeira, to Spain, and to the Canaries. Thence its cultivation, and the art of making sugar, were extended by different nations of Europe to the West India Islands and the Brazils. In 1518 there were twenty-eight sugar works established by the Spaniards in St. Domingo, and Hawkins brought some of the sugar to England in 1563. The English planters were realizing great wealth in Barbadoes in 1650, although the Portuguese then supplied the greater part of Europe with sugar made in Brazil.

Chemical and Dietetical Properties of Sugar.—Sugar is a proximate principle of many vegetables, and is also found in the milk of animals. It is of a sweet and crystalline structure. There are four principal varieties—viz. *sucrose*, or cane sugar, including sugar from beet-root, turnips, carrot, maple, palm, Indian corn, and some fruits of tropical climates; *glucose*, including grape sugar, starch sugar, and the sugar generally found in dried fruits; *frucose*, the sugar as it exists in recent ripe fruits; and *lactose*, or the sugar found in the milk of animals. The crude plant, or the newly-expressed juice of the sugar-cane, contains water, sugar, gum, green fecula, extractive, gluten, acetic and malic acids, acetates of lime and potash, supermalate and sulphate of lime, and lignine; by the removal of such of these principles as contain nitrogen, especially the gluten, the nutritive power of sugar is sensibly diminished; and thus loaf sugar is less nutritive than brown sugar.

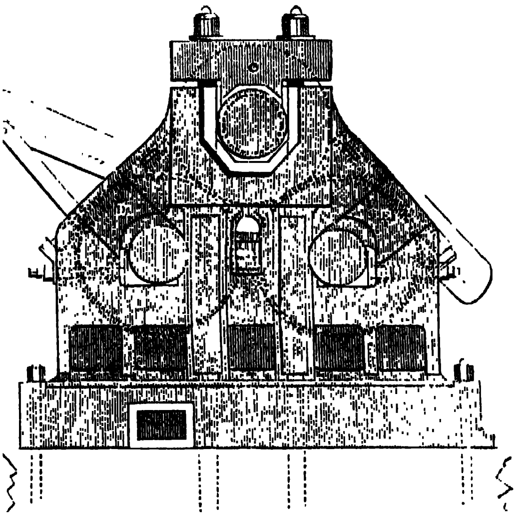
In treating of the dietetical properties of sugar, it is necessary to view it in a variety of conditions. In extra-tropical climates sugar was formerly regarded as a luxury, but has now become an indispensable necessary of life; in tropical countries it is a universal article of subsistence, partly as real sugar, and partly, and more generally, as it occurs in the cane, which is either simply chewed or sucked, or softened by previous boiling. In the sugar colonies the ripe sugar cane is one of the most nutritious substances, and is highly relished by the negroes. However harmless most saccharine vegetables may prove to persons in health, there cannot be a doubt but that taken in large quantities they affect the digestive organs. They are said to induce corpulence, and part of Banting's system consists in dispensing with their use. The blood of a perfectly healthy individual contains no appreciable quantity of sugar; but in diabetes sugar exists in the blood, and in the urine it is evidently proportional to the amount of sugar or starch

contained in the food of the patient. It must be remembered that in the process of digestion the starch taken into the stomach is converted into sugar. Persons of bilious habit ought likewise to be sparing in its consumption.

Sugar, though prone to fermentation in a dilute state, possesses when concentrated great antiseptic properties, and is extensively employed to preserve both animal and vegetable substances from decomposition. Sometimes the sugar existing naturally in many fruits is sufficient to insure their preservation, as in figs and raisins, especially if the season has been bright and warm, when a greater quantity of sugar is elaborated. In other cases sugar is added, as in many preserves and jellies. If added to meat, fish, &c., it renders less salt necessary for keeping them, and retains more of the natural taste and flavour. Many medicinal substances, as well as flavours and colouring principles, are preserved by means of this substance.

Culture.—Commercial cane-sugar is made from species of Saccharum, especially *Saccharum officinale*, a genus of grasses of the tribe Andropogoneæ, of which subdivision the cultivated sorghum and broom corn are familiar examples. The height attained by the canes, their colour, the length of their joints, and many other particulars, vary with different species, with the character of the soil, and with the modes of culture adopted. The stems vary in height from 6 feet up even to 15 feet, and are divided by prominent annular joints into short lengths. Long narrow leaves sprout from each joint; but as the canes approach maturity all those from the lower joints fall off. The outer part of the cane is hard and brittle, but the inner consists of a soft pith, which contains the sweet juice, and this juice is elaborated separately in each joint. The canes are usually propagated by slips or cuttings. These are planted either in holes dug by hand, or in trenches formed by a plough, about 8 to 12 inches deep; the earth being banked up upon the margin, and well manured. When the plough is used, it is returned along the furrow, so that the earth may be thrown up on each side of the trench. Two or more slips are laid longitudinally at the bottom of each hole, and covered with earth from the banks, to the depth of 1 or 2 inches. In about a fortnight the sprouts appear a little above the earth, and then a little more earth from the bank is put into the hole; and as the plants continue to grow the earth is occasionally filled in, by little at a time, until, after four or five months, the holes are entirely filled up. The planting usually takes place from August to November, and the cutting in March or April. The maturity of the cane is indicated by the skin becoming dry, smooth, and brittle; by the cane becoming heavy, the pith gray, approaching to brown, and the juice sweet and glutinous. The canes which grow immediately from the planted slips are called *plant-canes*; but it is usual, in the West Indies, to raise several crops in successive years from the same roots; the canes which sprout up from the old roots or *stoles* being called *rattoons*. The latter are not so vigorous as the original plant-canes; but they afford better sugar, and that with less trouble in clarifying and concentrating the juice. The old practice of the West Indian colonists was to plant one-third of the cane grounds every year, so as to obtain one crop from plant-canes and two from rattoons; but latterly more dependence has been placed upon rattoons. The canes should be cut as near the ground as possible, because the richest juice is found in the lower joints; and after cutting them it is considered well to cut the stumps down a few inches below the surface of the ground, and to cover them up with mould. One or two of the top joints of the cane are cut off, and the remainder is divided into pieces about a yard long, tied up in bundles, and carried immediately to the mill. The upper branches of the cane are used as food for cattle, and the remainder of the waste forms a valuable manure, for which purpose the *trash*, or waste from the mill, is admirably suited, though much of it is usually consumed as fuel.

Manufacture.—The operation of cutting the canes is so adjusted as to keep pace with the action of the mill by which the juice is to be pressed out, so that the canes may be crushed or ground while quite fresh. The common horizontal cane-mills of the West Indies consist of three heavy cast iron rollers, usually from 24 to 28 inches in diameter and about 48 inches long, and they are placed side by side in a strong frame, with contrivances for varying, in a slight degree, their distances from each other. The moving power, which may be horses, wind, water, or most generally steam, as shown in Plate II. figs. 2 and 3, is applied to the upper roller, and communicated from it to the others by cogged wheels, as shown in cut. In using the mill the canes are applied in a regular layer or sheet



to the interval between the first and second rollers, C and D, which seize and compress them violently as they pass between them. The ends of the canes are then turned so that they may pass between the first and third rollers C and E. As these are placed nearer together than the first and second, they compress the canes still more, so that on leaving them they are reduced to the form of dry splinters, which are called cane-trash, and are used as fuel in heating the vessels for evaporating the juice. Channels receive the liquor expressed from the canes, and conduct it to the vessels in which it is to undergo the succeeding operations.

Cane-juice, as expressed by the mill, is an opaque slightly-viscid fluid, of a dull gray, olive, or olive-green colour, of a sweet balmy taste, and of a specific gravity varying from 1·033 to 1·106. It holds in suspension particles of solid matter from the cane, a considerable portion of which are separable by filtration or repose. The juice is so exceedingly fermentable that in the climate of the West Indies it would often run into the acetous fermentation in twenty minutes after leaving the mill if the process of clarifying were not immediately commenced.

The method of clarification practised in the West Indies is as follows:—The juice is conducted by channels from the mill to large flat-bottomed coppers or open pans, called *clarifiers*, which contain from 300 to 1000 gallons each. Each of these clarifiers is placed over a fire, which may be regulated or extinguished by a damper, and each is supplied with a stopcock or siphon for drawing off the liquor. When the clarifier is filled with juice a little slaked lime is

added to neutralize it; the lime, which is called *temper*, being previously mixed with a little water to the consistence of cream. As the liquor in the clarifier becomes hot, the solid portions of the cane-juice coagulate, and are thrown up in the form of scum. The damper is then closed, the fire dies out, and after an hour's repose the liquor is ready for removal to the first of the evaporating pans. The clarified juice, which is bright, clear, and of a yellow wine colour, is transferred to the largest of a series of evaporating coppers or pans, three or more in number, in which it is reduced in bulk by boiling. These evaporators are placed over a long flue, heated by a fire at one end, over which the smallest of the coppers, called the *teach*, is placed. In the process of boiling impurities are thrown up in the form of scum, which is carefully removed, and lime-water is sometimes added. In the teach the liquor is boiled down to as thick a consistency as is considered necessary for granulation. The concentrated syrup is ladled or skipped from the teach, either immediately into open wooden boxes called *coolers*, or into a large cylindrical cooler, about 6 feet wide and 2 deep, from which it is afterwards transferred to the smaller coolers, or rather crystallizing or granulating vessels. The sugar is brought to the state of a soft mass of crystals imbedded in molasses, a thick, viscid, and uncrystallizable fluid.

Curing the Sugar.—Supposing the sugar granulated, the manufacturer has a pasty mass of small sugar crystals imbedded in a coloured adhesive syrup, and his next task is to separate the latter from the former so far that the sugar shall not retain enough syrup to subsequently drain to an appreciable extent during travel or storage.

The old and still largely used method is to fill the granulated and cooled mass into open hogsheads, standing on racks over a large cistern, and allowing the syrup to slowly drain away by gravitation through holes in the bottom, which are loosely stopped by plantain stalks. The other method, which is generally employed for the better class of vacuum-pan sugars, is by the use of the centrifugal machine. In the latter case it is generally advisable to render the cool, set mass of granulated sugar somewhat more fluid by mashing it up with some extra syrup, in order to facilitate its even distribution in the sieve of the centrifugal, so as to promote even drainage, and diminish the severe vibration which occurs when the centre of gravity of the rotating mass does not coincide with the centre of revolution.

The rough-and-ready method of boiling down the juice over the open, fire just described, results, as might be expected, in great destruction of sugar, and production of those brown products of its decomposition called "caramel." Many attempts have been made to substitute an apparatus which should concentrate the clarified juice at a lower temperature than is possible in the open pans. One of the most su . essful appliances, Fryer's Concretor, is shown ir our Plate. In working it the clarified juice is first run over a series of shallow trays, A A, in a stream of about half an inch deep; these trays are divided by ribs running from one side nearly to the other, so that each tray forms a continuous narrow serpentine channel, in traversing which the juice passes six times from side to side of the tray.

In the largest size there are ten of these trays placed end to end, and having connections so arranged that the juice can flow freely from end to end of this series; thus (the length of the series of trays being about 48 feet) the juice has to traverse nearly six times this distance before it passes away to undergo a further process of concentration in the revolving cylinder, B.

Heat is applied to the bottom of these trays by means of the furnace, the flame of which passes under the whole length; the juice is concentrated by means of this process to a density of from 30° to 34° Beaumé. After leaving the trays the juice passes into the revolving cylinder, B, where it is made to expose a very large surface to the action of heated air drawn through the cylinder by means of a fan. The air itself is heated by passing among and around a number of tubes in the air heater, C, through the inside of which tubes the products of combustion pass to the chimney.

In this cylinder the concentration is continued until the material has attained such a consistency that it drops in large flakes instead of flowing in a continuous stream. When this degree of consistency is attained, it is discharged from the cylinder into casks, or any other convenient receptacle, and in cooling becomes a solid mass, which without any further manipulation is ready for shipment.

The whole of the operations mentioned above do not occupy more than about half an hour, while the supply of the juice to the machine and the discharge of concrete from it are each of them continuous, or nearly so, both objects being effected without stoppage and without any interference with the working of the machine.

No molasses is made, but the average yield of concrete is about 2 lbs. to the gallon of juice, gauging $10\frac{1}{2}$° Beaumé. The material thus produced sets into a solid mass, which contains uninjured in quality or colour all the saccharine matter held in the juice from which it is made.

Another appliance used for this object is the vacuum-pan, which is described under the refining process.

In place of crushing the can between rollers the sugar is sometimes extracted by cutting it into slices and dissolving out the soluble constituents with water. This "diffusion" process, as it is called, was first adopted at the Aska Works, Gangam, Madras, and has there been found to yield results superior to the mill—the total sugar, with molasses, being 30 to 45 per cent. greater, owing to the far more perfect extraction of the juice in the first case. Not only is the sugar removed more perfectly from the trash, but the juice is so much purer than ordinary mill juice, that after neutralization with lime it has a pale sherry colour, and gives an insignificant amount of scum on boiling. The sole difficulty of the process lies in keeping the knives which slice the cane sufficiently sharp.

When it leaves the curing-house the sugar is packed in hogsheads for shipment as raw, brown, or Muscovado sugar, and in this state it is commonly exported from the West Indian colonies. The sugar loses usually about 12 per cent. in weight by the drainage of the remaining molasses from it while on ship-board.

Refining.—The crude cane-juice contains, besides sugar and water, the impurities, earthy insoluble particles, fragments of the crushed cane or megass, albumen, casein, wax, soluble colouring matter, and soluble salts. The process of refining is for the purpose of removing the impurities and colouring matter from raw sugar, and producing pure white loaf sugar, crystals, large crystal or coffee sugar, and crushed and pulverized sugar. Clayed sugar, also called Lisbon sugar, is raw sugar that has been subjected to a certain degree of refining. The sugar is removed from the coolers into conical earthen moulds called *formes*, each of which has a small hole at the apex. These holes being stopped up, the formes are placed, apex downwards, in other earthen vessels. The syrup, after being stirred round, is left for from fifteen to twenty hours to crystallize. The plugs are then withdrawn to let out the uncrystallized syrup, and the base of the crystallized loaf being removed, the forme is filled up with pulverized white sugar. This is well pressed down, and then a quantity of clay mixed with water is placed upon the sugar, the formes being put into fresh empty pots. The moisture from the clay filtering through the sugar, carries with it a portion of the colouring matter, which is more soluble than the crystals themselves. By a repetition of this process the

sugar attains nearly a white colour, and is then dried and crushed for sale. There is a process for whitening the sugar by forcing the moisture and the colouring matter out of it by the action of a vacuum filter, but the general practice is to bring it to England in the state of raw brown sugar, to be either used in that state or to be refined into loaf sugar.

The art of refining sugar, as well as that of extracting it from the cane, is supposed to have been brought to Europe from the East, probably from China, but at what time is uncertain. Stow's "Survey of London" states that sugar-refining was commenced in England about 1544. For many years the process of refining was to add to the solution of raw sugar blood, eggs, and lime-water to neutralize acid; heat was then applied, the scum was removed, the semi-crystallized solution was poured into moulds to drain, and the hardened loaves were trimmed, dried, papered, and were ready for market. The method is almost entirely superseded by a far more perfect form of filtration, which removes the colour and impurities with considerably less waste of sugar. Few manufacturing operations, in fact, have undergone of late years more important changes than this: improved chemical mixtures and the application of a vacuum at a particular stage of the operations having greatly improved the whole of the arrangements. The present mode of conducting the operations is generally as follows:—

The raw sugar, at the sugar-refinery, is transferred from the casks into large circular vessels called *blow-up cisterns*, in which it is mixed with water, and with a small quantity of lime dissolved in water so as to form a milky fluid. The mass is heated by steam, which is forced by its own pressure through small apertures in copper pipes, which are laid along the bottom and sides of the vessel, and the perfect solution of the sugar is aided by stirring with long poles or oars. The liquor is allowed to flow from the blow-up cistern to a range of filtering vessels in a room beneath. The filters are tall vessels 6 or 8 feet high, of cast iron or wood, having cisterns at top and bottom, and each filter contains about sixty cloth or canvas tubes, closed at their lower ends, but communicating at their upper ends, by which they are suspended, with the upper cistern. Within each of these tubes is a bag of thick close cotton cloth, which, being much larger in diameter than the tube in which it is inclosed, is necessarily folded together. By this device a very extensive filtering surface is obtained in a small compass, and as the liquor from the upper cistern cannot escape from the inner bags except by percolating through the meshes of the cloth, it becomes, as it drops into the lower cistern, very clear and transparent, most of the solid impurities remaining in the bags. On leaving the filter the syrup, though clear and transparent, is of a reddish colour, and the removal of this tinge is effected by filtering the syrup through from 15 to 30 feet of animal charcoal placed in a vessel which has a perforated false bottom, covered with a piece of cloth, through which it percolates slowly, and is rendered perfectly colourless. The charcoal is granulated, and after a certain amount of use it requires cleansing and reburning, when most of its purifying power is recovered, and it may be again used. The liquor as it flows from the charcoal filter is a transparent mixture of pure sugar and pure water. The latter element must now be expelled, and the only means of doing this is the application of heat.

In the evaporation or concentration of the clarified syrup, which forms the next part of the refining process, the boiling is effected in a vacuum, at a temperature of about 140° Fahr., instead of by an open fire at a temperature of about 240° Fahr., as formerly. This is one of the greatest improvements in the manufacture, and results in an enormous saving of fuel as well as in producing better sugar. All liquids boil at lower temperatures when the pressure upon them is lessened. The pressure exerted by the atmosphere upon liquids in open vessels varies from 14 to 15 lbs. per square inch. In a perfect vacuum no such pressure exists, and therefore liquids boil at lower temperatures there than in open vessels. The vacuum sugar-pan (Plate II., fig. 1) consists of a close copper vessel, the several parts of which are united by flanges, with packing between the joints to render them perfectly air-tight. The middle portion of this vessel is from 6 to 7 feet in diameter; the upper part is convex or dome-shaped, and the bottom is also convex, but the convexity is less. The bottom of the pan is double, the cavity between the inner and outer bottom forming a receptacle for steam, and there is also a coiled steam-pipe just above the upper bottom. There is one pipe of communication with the vessel of clarified syrup, one with the vessel which is to receive the crystallized sugar, and one with an air-pump, and there are many valves, gauges, and other subsidiary apparatus. In using the pan a quantity of sugar solution is admitted, and the air-pump is set to work to extract all the air from the pan, in order that the contents may boil at a low temperature. The evaporation proceeds; and to enable the person who superintends the process to ascertain when the syrup is sufficiently evaporated, the pan is supplied with a very ingenious appendage called the *proof-stick*, by which a little of the sugar can be taken out and its state ascertained by the touch. As the concentration of the liquid in the vacuum-pan proceeds, crystals of sugar begin to form, and the skill of the sugar-boiler is shown by the uniformity of the crystals he produces. As the water is evaporated and the crystals increase in size more liquid is added, and by the time the vacuum-pan is full the contents have thickened, by the formation of crystals of sugar, into a mass of the consistency of thick gruel.

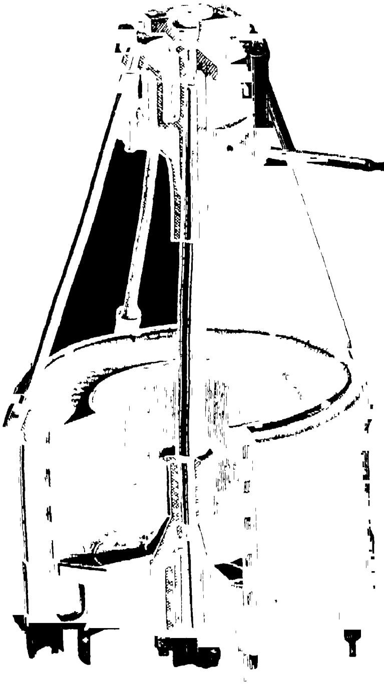
The syrup thus concentrated is run off into large conical formes, holding from 1 to 10 cwts. of sugar, and it is here allowed to cool and complete its crystallization before the plugs at the bottom of the pots or formes are withdrawn. When this is done, from one-fourth to one-third of the quantity which has remained in a fluid state runs off as molasses, and is re-boiled, yielding an inferior quality of sugar. When the contents of the formes have stood a sufficient time the process is complete, and the article is ready for use as common brown Muscovado sugar.

Another process for expelling the treacle is that of the centrifugal machine (see woodcut, next page), the action of which is the same in principle as that which results when a mop is twirled to get rid of the water. This machine is simply a drum of 3 or 4 feet diameter, and 12 to 18 inches high, revolving at a great velocity on a vertical axis. The sugar, either direct from the vacuum-pan or after it has been allowed to cool, is put, still mixed with the treacle, into the machine. As soon as it acquires a high velocity its contents are forced by the centrifugal action against the drum, the cylindrical portion of which is made like a sieve, and admits of the escape of the treacle, but retains the crystals of sugar. The speed is 1000 revolutions per minute, and the tendency of the treacle to escape is 514 times its own weight—the treacle thus having 514 times more force to fly off than it has to drop off the crystal by mere force of gravity in the formes.

If loaf sugar is desired the syrup or sugar from the vacuum-pan is transferred into moulds of a conical form, which were formerly made of coarse pottery, but are now usually of iron. These moulds, like those used in the claying process, have orifices at their points, which are stopped up before they are filled with sugar. They are arranged on the floor in rows, and immediately after the sugar is poured in it is stirred round, to diffuse the crystals equally through the semifluid mass. They are then left for several hours, that the sugar may become solid—after

which they are removed to another room, and their points being unstopped, and the concreted sugar at the apex being pierced by a steel wire, they are set in earthen jars, that the uncrystallized fluid may drain from them.

The apartment is kept at a warm temperature to facilitate the flow of what is afterwards sometimes sold as treacle, or, when further clarified, as golden syrup. To entirely remove the coating of coloured treacle which still hangs about the crystals of sugar, a small portion of the saturated solution of pure white sugar is poured on the top



Centrifugal Machine.

of the forme. This does not dissolve any more sugar, but mixes with the sticky coatings of treacle or syrup adhering to the crystals, and makes them fluid enough to flow down to the bottom of the forme, leaving the crystals clear of syrup or treacle, and consequently free of all colour. The liquor drained from the loaves, when it is re-boiled, forms loaves of an inferior quality, and the drainings from the inferior loaves are boiled into the yellow description of sugar known among refiners as bastards. The loaves, when thoroughly drained, are wrapped in paper and dried in stoves heated by steam.

The loaf-sugar refining industry in the United Kingdom has of late years laboured under very severe disadvantages, owing chiefly to the system of "bounties" carried out in France and Germany. The duty levied on sugar there is measured by the estimated yield of refined sugar from a certain quantity of raw material. If this yield be under-estimated then the drawback granted on exportation operates as a bounty, and as a matter of fact the yield is systematically under-estimated. The consequence is that the foreign refiner, on exporting his sugar, is given a much larger sum as drawback than he paid as duty, the difference being clear gain to himself. Against manufactures of loaf sugar thus subsidized—for that is what it amounts to —no British manufacturer has any chance, and British loaf sugar is becoming a thing of the past. International conferences have several times been held with the view of modifying the system, and a parliamentary committee sat in 1880 to consider a proposal made of placing a countervailing duty upon all bounty-fed sugar brought into the United Kingdom. No satisfactory arrangement, however, has yet been devised to meet the difficulty. The imports of foreign refined sugar into the United Kingdom increased from 3,036,074 cwts. in 1880, to 6,367,027 cwts. in 1886. Sugar-refining, apart from loaf-sugar making, is carried on to a large extent in England and Scotland. Formerly sugar was sometimes adulterated with chalk, plaster, sand, and potato-flour; but the decrease in price of late years, and the ultimate removal of the duty in 1874, have lessened many of the inducements to these frauds.

Sugar boiling is the art or business of the confectioner or baker—the candying of sugar. The stages are as follows:—Well clarified and perfectly transparent syrup is boiled until by means of a skimmer dipped into it, a portion can be touched between the forefinger and thumb, which, on opening them, is drawn into a small thread which crystallizes and breaks. If boiled again it will draw into a large string, and if bladders may be blown through the drippings from the ladle with the mouth, it has acquired the second degree, and is now called *bloom sugar*. After still further boiling it arrives at the state called *feathered sugar*. To determine this, redip the skimmer and shake it over the pan, then give a sudden flirt behind and the sugar will fly off like feathers. The next degree is that of *crackled sugar* in which state the sugar that hangs to a stick dipped into it and put directly into a pan of cold water is not dissolved off, but turns cold and snaps. The last stage of refining this article reduces it to what is called *caramel sugar*, proved by dipping a stick first into the sugar and then into cold water, when on the moment it touches the latter, it will, if matured, snap like glass. It has now arrived at a full candy height. Care must be taken throughout that the fire is not too fierce, as by flaming up against the sides of the pan it will burn and discolour the sugar; hence the boiling is best conducted by steam heat. Any flavour or colour may be given to the candy by adding the colouring matter to the syrup before boiling it, or the flavouring essence when the process is nearly complete.

Beet-root Sugar is described in the article BEET. The manufacture is in a flourishing state in Germany, and competes very successfully with that from the sugar-cane. *Maple-sugar* is obtained by piercing the trunks of the sugar-maple trees in February, March, and April. The trees most fit for tapping are from twenty to thirty years old. The juice trickles out through tubes of elder or sumach into vessels, and in two or three days afterwards it is boiled down to one-third of its original bulk, clarified, filtered, granulated, and sometimes refined. The average yield of a tree is one quart in twenty-four hours. A tree may be tapped for twelve years in succession, yielding two or three quarts annually.

It was for many years known that sugar or *glucose* was to be obtained by a chemical process—in which the starch is changed into grape sugar, which is rather less sweet than cane sugar—from maize, or Indian corn, as it is more generally called; but it is only within recent years that the manufacture has been developed to any particular extent. Mr. T. L. Stewart, of Pennsylvania, found by experiments that sugar, in much larger quantity than had before been supposed, could be made from the stalks of maize if gathered when green, and before the grain is fully matured. Mr. Stewart also found that a large quantity of sugar can be obtained from sorghum, the Indian or Chinese millet, which grows as strongly as maize, and although demanding even a little more sun—clear sun is the special demand of maize, which, sun being granted, will ripen almost anywhere—is found over nearly as wide an area as maize itself. The sorghum yields more sugar than the maize, giving 10 lbs. to the gallon of syrup, while

each acre planted with the grass can be made to produce from 200 to 300 gallons of syrup. In other words, this hardy grass will yield 1000 lbs. of sugar per acre. Maize yields a fifth less, but the almost embarrassing profusion with which this corn is grown in the United States is best shown by the fact, which may be easily demonstrated, that if one acre in 50 of the area devoted to the growth of Indian corn in the United States were appropriated to the growth of either corn or sorghum for sugar, and properly worked up, the product would be quite sufficient to supply the demand of the United States.

Consumption of Sugar in Great Britain.—Although sugar was known in England as early as the twelfth century, for more than 400 years afterwards honey continued to be the principal ingredient in sweetening liquors and dishes. In the latter part of the seventeenth century, when tea and coffee began to be introduced, sugar came into more general demand. In 1700 the quantity consumed in Great Britain was about 10,000 tons; in 1710, 14,000 tons; in 1731, 42,000 tons; in 1754, 53,270; in 1770-75 the yearly average was 72,500 tons; and in 1786-90, 81,000 tons.

Both the more extensive production and the reductions of duty have contributed to the extraordinary increase in consumption of sugar in the United Kingdom within the last twenty-five years. During the first forty years of the present century the rate of consumption was singularly stagnant. In the fourteen years of almost ceaseless war with which the century opened the rate of consumption was 18½ lbs. per head of the population. In 1815, when both the duty and market price were raised, so that together the cost to the retailer was £4 12*s.* 5*d.* per cwt., or nearly 10*d.* a pound, the consumption fell to 15 lbs. per head. In the following thirty years of peace it did not exceed 17¼ lbs. In the following years, however, the rate of consumption steadily rose until, after the reductions of duty in 1870, it reached 47 lbs. in 1871, while a further reduction sent up the rate in 1873 to the large quantity of 52 lbs., or 1 lb. per week per head of the entire population of the United Kingdom. The annual consumption is now about 54 lbs. per head of the whole population, or 36 lbs. more than in the earliest years of the century, and 20 more than in 1860, increasing so much, of course, the comforts of the people.

The duty on sugar imported into the United Kingdom was entirely repealed in May, 1874, and it is impossible to ascertain accurately the quantity retained for home consumption in that and subsequent years. The nearest approach to it which can be given is the excess of imports over exports, which have been as follows:—

	Imports. Cwts.	Exports. Cwts.	Excess of Imports over Exports. Cwts.
1874,	16,888,590	1,864,236	15,024,354
1875,	19,077,585	2,119,355	16,958,230
1876,	18,369,785	2,475,416	15,894,369
1877,	20.050,797	1,119,041	18,931,756
1878,	18,212,329	1,493,898	16,718,431
1879,	20,738,205	1,489,412	19,248,793
1880,	20,937,687	1,679,057	19,258,630
1881,	21,441,847	1,613,810	19,828,037
1882,	22,605,348	1,693,686	20,911,662
1883,	23,650,547	2,022,427	21,628,120
1884,	23,886,552	1,707,092	22,179,460
1885,	24,745,605	1,278,906	23,466,699
1886,	22,508,033	1,498,359	21,009,674

It will be observed that the consumption of sugar in the United Kingdom has now reached the enormous total of 1,100,000 tons, equal to 68 lbs. per head of the population, or four and a half times the quantity consumed by each person in 1840. This represents an annual expenditure on the article amounting to £30,000,000, or about half the amount spent on bread when the wholesale price of wheat is under 40*s.* per quarter.

Customs Duties charged on Sugar.—The duties on this article have varied very considerably. In 1681 it was only 1*s.* 6*d.* per cwt., but in the reign of Queen Anne it had increased to 3*s.* 5*d.* per cwt. Small additions were made in the reign of George II., but up to 1780 the duty did not exceed 6*s.* 8*d.* per cwt. In 1781 an addition was made, and in 1787 the duty was raised to 12*s.* 4*d.* In 1791 it was increased to 15*s.* Many alterations have been made since that period; and looked at with the free-trade ideas of the present day, one of the most noticeable features displayed by them is the great difference which was for so many years made between the sugar produced in the British colonies and that grown in foreign countries—the latter having been for thirty years subject to more than twice the duty of the former. The high duty was, in fact, intended to be, and was almost, prohibitory, and so long as the British possessions were not only able to supply the wants of the United Kingdom, but also to furnish a considerable excess in addition for exportation to other countries, there was not so much objection to its magnitude. During the latter years of its operation, however, it became most oppressive, and for the average annual consumption for the three years ending 1844 the British public had to pay £6,944,645 for exactly the same quantity of sugar as they could have procured for £3,442,375 had the duties on foreign and colonial sugars been equal; or in other words, in these three years they paid not less than £10,327,125 solely to protect the British planters against foreign competition. Under these circumstances it soon became evident that the reduction of the prohibitory duty of 66*s.* per cwt. on foreign sugar was imperatively demanded, and it was partially effected in 1844, when the duty on that produced by free labour was reduced to 35*s.* 8⅓*d.* a cwt., slave-grown sugar still having to pay 66*s.* In the following year, when the duty on British colonial sugar was reduced to 14*s.* a cwt., that on foreign free-labour sugar was still further lowered to 23*s.* 4*d.* a cwt. In 1845 the distinction between the slave-grown and free-labour foreign sugar was abolished. The result of these reductions was shown in a very striking manner in the fact that the quantity of foreign sugar retained for home consumption in the United Kingdom increased from 98 cwts. in 1844 to 602,739 cwts. in 1846. From the latter year to 1854 the differences of the duties on foreign and colonial sugars were gradually more and more assimilated, and from the 5th of July, 1854, all distinctions were entirely removed, and the produce of every country in the world allowed to be imported on exactly the same conditions.

The financial effect of the various reductions in the duties on sugar are very interesting to trace, and may be briefly stated as follows:—In the year 1840, when high protective and to some extent prohibitory rates of duty were imposed on sugar, the revenue derived from that article was £4,450,000. The sugar duties were reduced in—

1845 to the extent of .	. £2,439,040
1847 " " .	. 53,152
1848 " " .	. 258,854
1849 " " .	. 355,257
1850 " " .	. 331,073
1851 " " .	. 359,801
1852 " " .	. 95,928
1853 " " .	. 78,793
Making a total remission of taxation in nine years of . . .	£3,971,901

Notwithstanding these large remissions, no less a sum than £4,744,757 was collected as duty on sugar in 1854.

The success of these financial measures, however, did not stop here. The consumption continued to increase under the lower duty until the revenue from sugar amounted in 1863 to £6,250,000. In 1864 the sugar duty was again reduced by one third, but still the amount realized in the following year was £5,193,816, an increase of 13 per cent. over the sugar revenue of 1840, although the rates of duty in 1865 were less than half those of 1840. The increase of revenue is easily explained by the fact that within the same period, under the successive reductions of duty, the total consumption had nearly trebled, while the rate of consumption per head had increased from 15 to 40 lbs. In 1870 the duties were reduced by half, and they were further reduced by half again in 1872. The rates were now merely nominal, the highest being 3*s.* a cwt., but even then a sum of about £2,000,000 was realized from the sugar revenue in this country.

In introducing his budget in 1874 Sir Stafford Northcote observed:—"It was four years ago that the great article of sugar, which had been the heroine of so many important budgets, and which had upset one if not more ministries, made what was supposed to be positively her last appearance as prima donna, when the then chancellor of the exchequer diminished the duty upon it by one-half, announcing that he was proposing a reduction which he conceived and hoped would be a final remission. But before two years had elapsed the right honourable gentleman found it necessary to repeat the operation, and last year the duty on sugar was again reduced by one-half, whereby a revenue derived from this source was raised which was comparatively small in proportion to the cost of its collection, and what is of more importance, bore a still smaller proportion to the annoyance and, I believe, the injury done to trade by the restrictions it imposed upon it. Therefore, it is not upon the principle of reducing an indirect duty, or a duty upon consumption, to balance a particular reduction made in direct taxation, but upon the principle that we find in the sugar duties as they at present stand a source of revenue which does more harm than it produces good upon the whole, that we have selected sugar as the article upon which to propose a remission of taxation. It is an article of the very first magnitude in the consumption of the country. I believe that next to corn it is the article of which the largest quantity is consumed in this country; it supplies our shipping with the largest amount of freight, and it enters more largely into the general processes of manufacture and consumption than any other article now subject to duty. Besides that, it is held out to us that if we abolish the sugar duty there is a reasonable prospect that England may become the great entrepôt of the sugar trade; and I think that is a consideration which all who are interested in the commercial prosperity of the country must regard as being one of first-rate magnitude."

The sugar duties thus finally disappeared from the British tariff, their whole history having shown how taxes on articles of general consumption may be judiciously relaxed, not only with pecuniary benefit to the consumer, but with remarkable profit to the national exchequer.

The table on opposite page exhibits the most interesting and significant particulars of the consumption, &c., of sugar in the United Kingdom during the present century. With respect, however, to the column "average rate of duty," it should be particularly observed that this is the average rate of duty actually *paid* on the sugar cleared for home consumption, and not the average of the rates *chargeable*. These, especially in earlier years, would be considerably higher. Down to 1844 the average was about £1 19*s.* From 1844 to 1848 the average rate was £1 6*s.* 8*d.*, omitting to reckon duties such as £8 8*s.* on foreign refined, such rate being simply prohibitive. In 1854, when differential duties as to country were entirely abolished, the average rate was 15*s.* 2*d.* This remained with very little variation until 1864, when other reductions made the average 10*s.* 4*d.* The duty was exactly halved in 1870, and again in 1872, reducing the average to 5*s.* 2*d.* and 2*s.* 7*d.* respectively. Bearing these average rates in mind, it will be observed that the more the duty was reduced the higher was the average duty actually *paid*, and the more was refined sugar imported.

Chemical Properties of Sugar.—Sugar is a general term applied to a number of organic compounds having a sweet taste, which are neutral and mostly crystalline. Sugars are found in abundance in many plants, and also in the milk and other secretions of animals. Some are fermentable and are called true sugars; others are non-fermentable and called saccharoids. The fermentable sugars may be again divided into glucoses and saccharoses. The glucoses have the formula $C_{12}H_{12}O_6$; the most important of these are dextrose or dextro-glucose, lævulose or lævo-glucose, maltose, galactose, and mannitose. Dextrose and lævulose have been already described under glucose, and maltose under its name. Galactose is obtained from lactose, or milk sugar, by boiling it with dilute sulphuric acid. It crystallizes in rectangular prisms, is dextrorotatory, and resembles glucose. Mannitose is obtained from the oxidation of mannite by platinum black; it has no action on polarized light; in other reactions it resembles dextrose. The saccharoses have the formula $C_{12}H_{22}O_{11}$. The principal are cane sugar, or saccharose, or sucrose, parasaccharose, lactose, melitose, and mycose; the three last named have been described under their several names. The unfermentable sugars or saccharoids are principally mannite ($C_6H_{14}O_6$), sorbite or sorbin ($C_6H_{12}O_6$), inosite ($C_6H_{12}O_6$), quercite ($C_6H_{12}O_5$), eucalyn ($C_6H_{12}O_6$), dulcite ($C_6H_{12}O_6$), and pinite ($C_6H_{12}O_5$). Except the two latter all have been already described under their respective names. Dulcite, or dulcin, or melampyrite is obtained from *Melampyrum nemorosum*, or cow wheat (natural order Scrophulariaceæ). It crystallizes in monoclinic prisms, melting at 190° C. (374° Fahr.) It has no rotatory power on polarized light. Pinite is obtained from the sap of the *Pinus Lambertiana* (natural order Coniferæ) of California. It is a very sweet sugar, crystallizing in nodules. It is dextro-rotatory. Glycocol ($C_2H_5NO_2$), a nitrogenous sugar, has been already described.

The most important of all these sugars, and that which is usually known commercially as sugar, is saccharose or cane sugar, which is now produced on an enormous scale from sugar-cane and beet-root, although glucose has also recently become an important manufacture. Saccharose crystallizes in monoclinic prisms, separating from its solutions on slow evaporation in large crystals in the well-known form of sugar-candy. From hot saturated solutions it is obtained in much smaller crystals of the same form. The crystals have a specific gravity of 1·606, and exhibit phosphorescence when broken. It dissolves in one-third of its weight of cold water, forming a syrup, which can be obtained of specific gravity 1·5504, then containing 99° per cent. of sugar. The solution turns a polarized ray of light to the right. It is insoluble in alcohol and ether. It melts at 160° C. (320° Fahr.) to a clear liquid, and solidifies on cooling to a transparent amorphous cake, which is an allotropic modification known as barley sugar; this gradually becomes opaque and crystalline on keeping. This change is quickly effected if before cooling it is rapidly pulled out and worked with the hands; it is then known as pulled sugar, which is perfectly crystalline. In this process a considerable amount of heat is developed. When the solution of saccharose is boiled for some time it is converted into dextrose and lævulose according to the following reaction:—

$$\underset{\text{Saccharose.}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Dextrose.}}{C_6H_{12}O_6} + \underset{\text{Lævulose.}}{C_6H_{12}O_6}.$$

TABLE

Showing the Quantity of Sugar annually consumed in the United Kingdom; the Average Rate and Aggregate Amount of Duty collected thereon; the Average Price, inclusive and exclusive of Duty; and the Average Amount consumed per Head of the Population from 1801 to the Repeal of the Sugar Duty:—

Year.	Total Quantity of Sugar Consumed.	Amount of Duty Paid.	Average Rate of Duty Paid per Cwt.	Average Price per Cwt. in Bond.	Average Price per Cwt., inclusive of Duty.	Population of the United Kingdom.	Consumption per Head.
	Cwts.	£	£ s. d.	£ s. d.	£ s. d.		Lbs.
1801–14 (average)	2,847,519	3,362,702	1 6 2	2 8 1	3 14 3	17,256,000	18
1815	2,523,326	3,454,412	1 10 7	3 1 10	4 12 5	19,118,000	15
1816	2,835,396	3,612,715	1 9 2	2 8 7	3 17 9	19,463,000	16
1817	3,680,692	4,434,051	1 7 1	2 9 8	3 16 9	19,772,000	21
1818	2,122,760	2,751,169	1 10 1	2 10 0	4 0 1	20,076,000	12
1819	3,111,018	3,996,589	1 8 8	2 1 4	3 10 0	20,398,000	17
1820	3,275,959	3,925,481	1 7 3	1 16 2	3 3 5	20,705,000	18
1821	3,412,245	4,188,997	1 7 4	1 13 2	3 0 6	20,985,000	18
1822	3,182,929	4,060,544	1 7 5	1 11 0	2 18 5	21,320,000	17
1823	3,466,209	4,407,476	1 7 4	1 12 11	3 0 3	21,672,000	18
1824	3,591,157	4,461,997	1 7 5	1 11 6	2 18 11	21,991,000	18
1825	3,271,388	4,176,673	1 7 4	1 18 6	3 5 10	22,304,000	16
1826	3,788,507	4,951,071	1 7 5	1 10 7	2 18 0	22,605,000	19
1827	3,539,865	4,650,224	1 7 2	1 15 9	3 2 11	22,893,000	17
1828	3,879,257	5,002,338	1 7 3	1 11 8	2 18 11	23,200,000	19
1829	3,809,710	4,896,271	1 7 4	1 8 7	2 15 11	23,535,000	18
1830	4,057,229	4,767,374	1 5 10	1 4 11	2 10 9	23,834,000	19
1831	4,076,253	4,650,606	1 4 2	1 3 8	2 7 10	24,083,000	19
1832	3,879,810	4,394,352	1 4 2	1 7 8	2 11 10	24,343,000	18
1833	3,766,411	4,414,346	1 4 2	1 9 8	2 13 10	24,561,000	17
1834	3,928,561	4,559,418	1 4 3	1 9 5	2 13 8	24,820,000	18
1835	4,022,850	4,667,920	1 4 2	1 13 5	2 17 7	25,101,000	18
1836	3,593,144	4,184,209	1 4 1	2 0 10	3 4 11	25,390,000	16
1837	4,048,665	4,760,576	1 4 0	1 14 7	2 18 7	25,676,000	18
1838	4,021,246	4,656,912	1 4 0	1 13 8	2 17 8	25,895,000	17
1839	3,830,393	4,586,936	1 4 0	1 19 2	3 3 2	26,201,000	16
1840	3,594,412	4,449,070	1 5 2	2 9 1	3 14 3	26,519,000	15
1841	4,057,900	5,114,390	1 5 2	1 19 8	3 4 10	26,730,000	17
1842	3,868,474	4,874,812	1 5 2	1 16 11	3 2 1	27,006,000	16
1843	4,028,326	5,076,326	1 5 2	1 13 9	2 18 11	27,283,000	17
1844	4,129,449	5,203,270	1 5 2	1 13 8	2 18 10	27,577,000	17
1845	4,856,680	3,574,471	0 14 9	1 12 8	2 7 5	27,875,000	20
1846	5,238,656	3,896,780	0 14 11	1 13 2	2 8 1	28,189,000	21
1847	5,805,638	4,405,237	0 15 2	1 7 8	2 2 10	28,093,000	23
1848	6,188,487	4,557,337	0 14 9	1 3 5	1 18 2	27,855,000	25
1849	5,980,824	3,912,170	0 13 1	1 5 2	1 18 3	27,632,000	24
1850	6,207,827	3,884,441	0 12 6	1 5 2	1 17 8	27,423,000	25
1851	6,571,626	3,979,141	0 12 1	1 5 2	1 17 3	27,529,000	27
1852	7,172,858	3,893,656	0 10 10	1 2 10	1 13 8	27,570,000	29
1853	7,487,589	4,083,836	0 10 11	1 5 0	1 15 11	27,663,000	30
1854	8,332,407	4,741,757	0 11 5	1 1 5	1 12 10	27,788,000	34
1855	7,547,157	5,058,500	0 13 5	1 6 9	2 0 2	27,899,000	30
1856	7,071,515	5,129,649	0 14 6	1 9 7	2 4 1	28,154,000	28
1857	7,419,518	5,055,034	0 13 8	1 15 7	2 9 3	28,359,000	29
1858	8,746,496	5,848,170	0 13 4	1 7 10	2 1 2	28,566,000	34
1859	8,884,299	5,935,909	0 13 4	1 6 3	1 19 7	28,774,000	35
1860	8,771,996	5,833,484	0 13 4	1 7 2	2 0 6	29,984,000	34
1861	9,180,986	6,107,330	0 13 4	1 3 8	1 17 0	29,196,000	35
1862	9,379,819	6,215,346	0 13 3	1 2 6	1 15 9	29,255,000	36
1863	9,452,794	6,249,815	0 13 3	1 1 10	1 15 1	29,434,000	36
1864	9,736,657	5,157,083	0 10 7	1 7 6	1 18 1	29,629,000	37
1865	10,603,526	5,193,816	0 9 10	1 2 9	1 12 7	29,862,000	40
1866	11,065,239	5,390,962	0 9 9	1 0 11	1 10 8	30,077,000	41
1867	11,692,519	5,584,659	0 9 7	1 2 6	1 12 1	30,335,000	43
1868	11,479,706	5,425,181	0 9 6	1 3 2	1 12 8	30,318,000	42
1869	11,739,093	5,388,652	0 9 2	1 5 4	1 14 6	30,914,000	43
1870	13,148,236	3,680,554	0 5 7	1 4 8	1 10 3	31,205,000	47
1871	13,166,890	3,039,022	0 4 7	1 6 5	1 11 0	31,513,000	47
1872	13,466,594	3,176,116	0 4 9	1 8 7	1 13 4	31,836,000	47
1873	14,795,214	2,255,092	0 3 1	1 5 5	1 8 6	32,125,000	52

The presence of a small quantity of sulphuric or other acid effects the change more rapidly. The same change is effected by yeast, and is the first step in the alcoholic fermentation.

Dilute nitric acid converts saccharose into saccharic acid ($C_6H_{10}O_8$). On boiling the oxidation is carried further, and oxalic acid is formed. Concentrated nitric acid converts it into nitro-saccharose, $C_{12}H_{18}(NO_2)_4O_{11}$. Heated alone saccharose is first converted partly into dextrose, and on further heating into caramel, a brown substance much employed for colouring wines, &c. Saccharose is distinguished from glucose by not turning brown with potash and by not reducing potassio-cupric tartrate. It forms compounds with alkalies called sucrates. Potassium sucrate ($C_{12}H_{21}KO_{11}$) and sodium sucrate ($C_{12}H_{21}NaO_{11}$) are gelatinous precipitates. The compounds with lime, baryta, and strontia are more important, and have recently come into use in sugar-refining as a means of increasing the yields of crystallizable sugar and getting rid of salts and other impurities, especially in refining beetroot sugar. These sucrates are crystalline precipitates, and are again dissolved in water, and the alkaline earths separated as carbonates by passing a current of carbonic acid through the solution. The formula of the barium compound is $C_{12}H_{22}O_{11}BaO$; that of the strontium is $C_{12}H_{22}O_{11}SrO$. In this process strontia is preferred, the poisonous character of baryta rendering its employment undesirable. There are several calcium compounds containing one, one and a half, two, and three equivalents of lime. The formula of the monocalcic sucrate is $C_{12}H_{22}O_{11}CaO$. The solution of this sucrate is employed in medicine as an easy means of administering lime. There is also a crystalline lead compound, $C_{12}H_{18}Pb_2O_{11}$.

Saccharimetry is the estimation of cane sugar in solution. If pure the specific gravity is sufficient indication of the amount present. It can also be estimated by the amount of carbonic acid given off, or the amount of alcohol obtained by fermenting the solution with yeast, also by the rotatory power of the solution, or by converting it into inverted sugar by heating with a dilute acid and estimating the quantity of cupric oxide reduced by it. Parasaccharose ($C_{12}H_{22}O_{11}$) is obtained from saccharose by spontaneous fermentation. It is crystallizable and dextro-rotatory, and reduces potassio-cupric tartrate. It is very soluble in water, and insoluble in alcohol.

Dietetic Properties of Sugar.—In treating of the dietetic properties of sugar it is necessary to view it in a variety of conditions. In extra-tropical climates sugar was formerly regarded as a luxury, but has now become an indispensable necessary of life; in tropical countries it is a universal article of subsistence, partly as real sugar, and partly (and more generally) as it occurs in the cane, which is either simply chewed or sucked, or softened by previous boiling. In the sugar colonies the ripe sugar-cane is one of the most nutritious substances, and is highly relished by the negroes. However harmless most saccharine vegetables may prove to persons in health, there cannot be a doubt but that taken in large quantities they affect the digestive organs. They are said to produce corpulence, and part of Banting's system consists in dispensing with their use. The blood of a perfectly healthy individual contains no appreciable quantity of sugar; but in diabetes sugar exists in the blood, and in the urine it is evidently proportional to the amount of sugar or starch contained in the food of the patient. It must be remembered that in the process of digestion the starch taken into the stomach is converted into sugar. Persons of bilious habit ought likewise to be sparing in its consumption.

Sugar, though prone to fermentation in a dilute state, possesses, when concentrated, great antiseptic properties, and is extensively employed to preserve both animal and vegetable substances from decomposition. Sometimes the sugar existing naturally in many fruits is sufficient to insure their preservation, as in figs and raisins, especially if the season has been bright and warm, when a greater quantity of sugar is elaborated. In other cases sugar is added, as in many preserves and jellies. If added to meat, fish, &c., it renders less salt necessary for keeping them, and retains more of the natural taste and flavour. Many medicinal substances, as well as flavours and colouring principles, are preserved by means of this substance.

SU'ICIDE (Lat. *sui; occido*, I kill, as in parricide, &c.) is the term usually applied both to the act of self-destruction and to him who commits it. The word, though made up of Latin elements, is not a real Latin word. It is first found in 1662 in an English book. It is evidently modelled on the Latin word *parricidium*. Shakespeare's word is "self-slaughter," for as yet "suicide" did not exist. The true Latin expressions were *Sibi mortem consciscere*, *Vim sibi inferre*, and the like.

The legal aspect of suicide is dealt with in the article immediately following this.

The most important distinctions among cases of suicide are founded on the circumstances which lead to its commission, especially the condition of mind which has preceded the act, and which in each case constitutes the disposition to self-destruction.

In many cases this disposition is only a part of the general perversion of the judgment in complete insanity; it thus exists in certain maniacs in combination with many other signs of a diseased mind. Some are merely melancholy; some are carried on by delusions which lead them, as if unintentionally, to suicide; some have sensations which they imagine may be cured by such violence as proves fatal; some are driven to the act by commands which they imagine they have received; some destroy themselves at the commencement of insanity, when they are conscious of the malady which threatens them; others in their convalescence, in horror at the excesses they have committed, or at the mere thought of having been deranged. There are also cases of monomania in which almost the only indication of insanity is the desire for self-destruction excited by a delusion respecting some melancholy event, some accidental or supposed coincidence, or by some fancied command.

There are conditions of the mind which are not called insanity (in the ordinary acceptation of the term), but which do not less strongly predispose to suicide. Such is especially that named *ennui* or *tædium vitæ*, for which, though it is thought by foreigners to be so common in England that Sauvages has called it "melancholia Anglica," we have in our language no term except the very inexpressive one, *spleen*. Such a state of mind is that of Hamlet (i. 2)—

> "Oh that this too too solid flesh would melt,
> Or that the Everlasting had not fixed
> His canon 'gainst self-slaughter! O God! O God!
> How weary, stale, flat, and unprofitable
> Seem to me all the uses of this world!"

Dido, Sapphô, Portia, and Mark Antony are famous examples of this class.

The state of the hypochondriac, though of somewhat the same kind, is less dangerous. He is persuaded, indeed, that his sufferings are irremediable, and that death would be a great relief to him; he even often talks of committing suicide; but he is irresolute in the use of the means of death, as he is anxious in the use of those of prolonging life; and if he do at last, after repeated postponements, attempt to destroy himself, the attempt is generally, through want of determination, abortive, and he again sinks into the same despondency and inactivity. In all these cases the suicide is of the chronic or prepense kind. Taken altogether, it is held by the best observers, that the various forms of insanity account for quite a third of the suicides.

In the acute or involuntary suicides, the predisposing condition of the mind is the result of circumstances which act rapidly, and pervert a judgment which, before their occurrence, might be deemed sound. Suicides of this kind are probably less frequent than those of the preceding; but they are usually more shocking, and attract more attention: they are especially common in large towns, or wherever men pursue great objects at great hazards.

Lastly, there are examples in which suicide is committed with perfect coolness, being adopted, after due deliberation, as the most judicious course which, in the circumstances of the case, and as far as the knowledge of the individual enabled him to judge, could be followed. Such are many of the cases in which men, finding themselves afflicted with incurable and painful diseases, have shortened that which they believed would be a miserable life; and of the same class are the suicides committed in accordance with national custom, or from superstition, or from patriotic motives. In these cases there is no disorder of the mind.

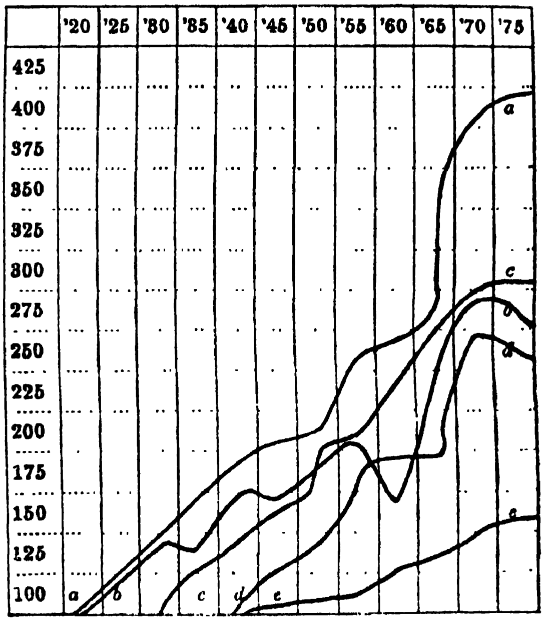
But the causes of any act of suicide are very rarely accurately known. In a celebrated series of suicide statistics M. Brierre de Boismont certainly found nearly a third (29 per cent.) of the victims had left a record of their last thoughts. These might be thought conclusive, yet on examination they are found often full of delusions, and are vitiated, even when clear-minded, by the too evident wish to put the case for suicide as favourably as possible. In some cases dissipation, passion, misfortune clearly point to the suicidal motive; but it is invariably the fact that the family of the suicide endeavours to hush up the painful occurrence, for it is felt by all men as a shame and an infamy. The universal rule is now to consider all suicides as at all events temporarily mad, though if this opinion be severely scrutinized it will be found not really defensible.

Although on these grounds the motives to suicide are not capable of scientific study, yet the facts of suicide, so far as the efforts of individuals to keep them back have failed, are among the most extraordinary. With more perfect data, more accurate results will hereafter follow; but it is impossible that the main conditions can be altered.

The first thing that strikes the observer is the curious regularity of suicides. In England, after a somewhat rapid increase at the close of the last century, we seem to have attained a sort of table-land; the numbers increase year by year, but not relatively faster than the population. Not so with other countries, which show a somewhat alarming rate of increase, all except Norway. In that favoured land the suicides in 1875 had come down to the level of England, whereas they used to be half as numerous again till 1862. This wonderful improvement in only thirteen years exactly coincides with the enactment of the present stringent regulations upon the sale and use of alcoholic liquors. It would be better if the number of abortive attempts at suicide were known, so as to be added to the unhappily successful cases; but this is manifestly impossible. It is known to be a large proportion. M. Brierre de Boismont, in his very careful researches, found 1864 attempts which failed against 4595 actual suicides—and no doubt there were more than he knew of. Again, some searching investigations in London in 1836–37 gave 155 attempts against 192 actual suicides, and in this only police-figures are taken. Perhaps we may guess from these and other calculations that the attempts which are made and fail number half as many as the actual suicides. But this is a mere guess, and must be reluctantly set aside in favour of the firm facts, which show a sufficiently alarming state of things even without the help of the large class of attempts and failures.

Many circumstances would lead us almost to assert that the total suicides are at least double of those recorded, so eagerly do friends, including family doctors, strive to falsify the records of such deaths.

Taking the suicides of Prussia, Sweden, and France, all which give long series of data, and contrasting them with those of England, we find that if we call the number which starts our series 100, the proportional increase of suicides from 1815 to 1875 in Prussia is from 100 to 422, and in Sweden from 100 to 283. For every 100 suicides in France in 1827 there were 303 in 1877; and for every 100 in 1837 in Saxony and in England and Wales, there were respectively 267 and 157 half a century later.



Curves showing the increase of suicide in various countries from 1815 to 1875, by divisions of five years, calling the initial number of suicides 100. *a*, Prussia; *b*, Sweden; *c*, France; *d*, Saxony; *e*, England and Wales.

It may be at once objected that the increase of population may be such as to nullify the effect of those curves of increase. It is found, in fact, to do so to a large extent in England, but not in the others. If we count how many suicides happen in these same countries per million inhabitants, we get the following results:—

NUMBER OF SUICIDES PER MILLION INHABITANTS DURING THE SAME PERIOD: THE SAME COUNTRIES.

	1815-20.	'25	'30	'35	'40	'45	'50	'55	'60	'65	'70
Prussia, .	74	83	89	96	103	110	99	130	123	122	142
Sweden, .	48	54	62	69	66	66	67	71	57	76	85
France, .	—	—	54	64	76	85	97	100	110	124	135
Saxony, .	—	—	—	—	158	198	199	248	215	261	297
England,	—	—	—	62	63	63	64	64	65	66	67

The great prevalence of suicide in Saxony, and its rapid progress in France and Prussia are almost astounding. Celtic races (*e.g.* Irish, Welsh, Highlanders, Bretons) and still more Slavonic races (Russians, &c.), are remarkably free from suicidal crimes. Whatever our sins in this respect may have been in the past in England, Montesquieu's famous dictum that ours is the home of suicide

is now as false as the cause he gave for it, namely, the dark cold climate we enjoy; for it is a most curious fact as to suicides that they occur chiefly in the warm bright seasons. Thirty-four calculations were made very carefully, covering data from eighteen different nations; and in thirty out of the thirty-four the maximum number of suicides occurred in the summer and the minimum in the winter; in three cases the maximum occurred in the spring, and in one case only in the autumn—to set against which one the autumn had the minimum number in four other cases. It is quite safe to say that winter lessens suicide.

A table of the monthly variation per thousand of suicides in the four great capitals of Europe will make this quite clear:—

MONTHLY AVERAGE PER 1000 SUICIDES IN FOUR GREAT CITIES.

	London.	Paris.	Berlin.	Vienna.
Jan.,	56	81	97	75
Feb.,	54	84	48	76
March,	62	82	117	86
April,	72	81	68	97
May,	103	103	112	119
June,	112	97	83	67
July,	124	104	97	101
Aug.,	115	93	112	43
Sept.,	94		59	89
Oct.,	85	78	68	90
Nov.,	65	66	66	74
Dec.,	58	59	73	83
	1000	1000	1000	1000

The reason of this lies on the surface, as with many other things about suicide. The quickening of vitality in the spring brings on nervous irritation and various mental affections. Suicide and madness go hand in hand; and though they are by no means indissolubly linked, as some would say, yet the same causes operate in both.

Similarly, the curious fact that suicides are found, according to voluminous French statistics, to be less on Friday, Saturday, and Sunday than the other days of the week, is at once explainable by the circumstance that Friday and Saturday are wage-taking days, Sunday is a wage-spending day, and all three are the jolliest half of the week for workmen. With Monday come empty pockets and aching heads, and the troubles of life assume colossal proportions, even to overwhelming weak characters.

It is also clear why not a fourth of the suicides are by women. Not, as some mockingly suggest, that women are afraid to kill themselves; but rather for the double reason that on the one hand the burden of life falls chiefly upon men, and on the other the habit of self-sacrifice is so strong with women that in suffering they feel a blessed joy which the sterner natures of men can never know. The man, like the oak, resists as long as his strength lasts, and is then broken by the storm; the woman, like the rush, bends before the blast, and bending, always is preserved. But two things must be observed: widows who have to struggle like men do surpass widowers in frequency of suicide, and the maximum of female suicides occurs before thirty years of age, whereas the maximum for males is after forty. Both facts tell in favour of the above hypothesis. The striking fact that suicide rapidly diminishes after about sixty or sixty-five years of age is also easy to understand; for it is in our nature to prize more highly anything which is hazardous, and further, in most men, the mind has settled and cleared itself and has become more philosophic.

It is not so clear why three-fifths of the suicides should be by day—another striking refutation of Montesquieu's claim for gloom as leading to suicide. The fact is so, however. Of the remainder one-fifth occur at dusk, one-fifth during the night, hardly any in the early morning, but most between six and noon.

A warm climate is found to be antagonistic to suicide, a cold climate less so; a temperate climate is the most dangerous in this respect. The two great areas of suicide in Europe are mid-France and mid-Germany. Spain and Italy are most fortunate, England and the Scandinavian countries are very high, but escape far better than the great central plains. This leads us to another observation. Perhaps the awful solitudes of mountain scenery might be thought to drive the lonely dwellers towards suicide. On the contrary, mountainous regions are particularly free from it. Plains and the courses of rivers bear the curse heaviest; and of course crowded cities are the very dwelling-places of suicide.

The tendency to suicide varies greatly among persons of different stations and occupations. The proportion of annual suicides among the middle classes is the greatest; then come the military, then the professional classes, then the artisans, and last the labourers; and, in general, the tendency to commit suicide is twice as great among artisans as it is among labourers. All the returns agree in proving that among the inhabitants of large cities and their neighbourhoods, suicides are much more frequent than among those who live in the rural districts. The proportion of suicides among the trades of luxury (dress, music, art, &c.) is very much larger than among industrial trades.

Suicides are disastrously imitative; and the publicity afforded by newspapers to any remarkable case of suicide, with full description of details, has unquestionably a pernicious effect, not only by suggesting a means to those already predisposed to the act, but also by its tending to lessen the natural horror of self-murder inherent in the human mind. The imitative propensity may even amount to an epidemic, as at Versailles in 1793, when no fewer than 1300 persons destroyed themselves. Some years ago, the Hôtel des Invalides, Paris, was the scene of one of these outbreaks; one of the veterans hanged himself on a crossbar in the institution; and in the ensuing fortnight six or seven others followed his example on the same bar, the epidemic being only stopped by the governor having the passage closed. In the same way one suicide having occurred from the Archway at Highgate (a lofty viaduct), four others occurred within as many months, when the parish authorities awoke to their responsibilities and stopped the epidemic with a simple iron rail. When Lord Castlereagh cut his throat a large number of persons followed his fatal example, and Miss Moyes, who leapt from the Monument in London, in 1839, only because her father had become poor and she must leave home to earn her own living, had frequent successors, till the present railing prevented further crime. It would be waste of space to insist upon what any observant person must have noticed, but one more fact may be mentioned. Ludwig II. of Bavaria committed suicide in the Sternberg lake (in 1885), on being confined as a madman; he was much beloved, and two romantic, beautiful, and wealthy young ladies, the Baronesses Guttenberg, made a practice of constantly rowing to the spot and casting flowers on the lake. After a few months they too threw themselves into the lake at this same place, and were drowned, locked in each other's arms. There was absolutely no real reason for the act.

The heredity of suicide, though not universally conceded, is admitted by most authorities, and according to some, the tendency to self-destruction is more disposed to be hereditary than any other form of insanity. In Bavaria it is proved that 18 per cent. of suicides are hereditary. Certainly a great number of those who put an end to their own lives are members of families in which instances of suicide or insanity have previously occurred, and the pro-

pensity is usually most strong at some particular age. Dr. Gall mentions the case of a Frenchman of property who killed himself, leaving a large sum of money to be divided among his seven children. None of these met with any real misfortunes in life, but all succumbed, before attaining their fortieth year, to the mania for suicide. The most glaring case of the large numbers quoted (they are found in every work of mark on insanity) is perhaps that given *in extenso* by Burrows, "Commentaries on Insanity" (London, 1828). A grandfather hanged himself. He had four sons, and many grandchildren by two of these sons. Of the four sons, one hanged himself, one cut his throat, and one drowned himself. Of the grandchildren, two became insane, one made several attempts on his life, two drowned themselves. The abominable wickedness of marriage in a similar case need not be pointed out, nor the truly awful spectre which must ever dog such unhappy offspring, who would, if thoughtful men, live in perpetual fear of its ghastly appearance, and would be not unlikely to be driven mad by that very fear alone.

With respect to the treatment of those among the insane who exhibit a tendency to self-destruction, there can be no other deviation from the ordinary treatment of insanity than that which consists in the careful removal from them of all means by which their intention may be accomplished. Both for these and for those who show no other sign of insanity than their desire for death, the most successful remedy is the giving full occupation for the time; this is indeed essential to the safety of all who show any disposition to suicide. The occupation, moreover, should be one which will carry the mind as far as possible from the subjects on which it is morbidly sensitive, or on which it has been accustomed to dwell too intently. Above all, a person suspected of an intention to commit suicide should be kept carefully from the contemplation of histories of self-destruction.

In this country, year after year, more than 1500 men and women, driven to desperation by their own folly or by some overwhelming misfortune, seek refuge from trouble in death; some of these—it is not recorded how many—belong, of course, to the class of irresponsible beings whose deficient mental organization incapacitates them from being safe custodians of their own lives. The state of England, bad enough in this respect, seems cheerful, however, beside the 5300 yearly suicides of France. Tl extraordinary regularity with which tl.. same means are employed for the same end is not the least curious feature in these statistics. Hanging has always been the mode most commonly adopted, and twenty-eight out of the yearly ratio of sixty-seven per million suicides always fall under this head. Cutting or stabbing, and drowning, accounting for an almost equal proportion (twelve and eleven respectively out of the sixty-seven per million), come next in order of frequency, women nearly all preferring drowning; then follow poisoning (seven) and gunshot wounds (three), the residue (six) not being specifically described, but suffocation by charcoal, &c., accounts for a large part. The ratio of suicides by means of fire-arms was three per million in each one of the eight years, and the other ratios show little or no variation.

The number of suicides increases in a direct ratio to the spread of education and civilization. Suicide was practically unknown among the frequently ill-treated Negro slaves of the United States, before the abolition of slavery, for instance. In Prussia, the most highly educated country in Europe, the annual average of suicides per million inhabitants is 240—more than double the average of France, and nearly fourfold that of England. Out of 151 suicides in New York in 1883 no less than 70 were Germans. On the other hand, in Spain the average of suicides is only fourteen per million inhabitants.

The peculiar freedom from suicide of the Jewish people has often been observed. Only nine cases are recorded in all the 4000 years covered by the annals preserved to us in the Bible. On the other hand paganism in some of its forms, especially Stoicism, actually advocated suicide. This is Roderigo's view ("Othello," i. 3):

"It is silliness to live when life is a torment."

The general feeling of the Stoics was to use suicide as a philosophical argument; for since we have the liberty to depart (though the better of the philosophers pictured such departure as like the soldier quitting his post) we were absurd if we quarrelled with the natural evils of life, since suffer them by our own choice. Sokrates, Plato, and Aristotle, Virgil, Pliny, and Plôtinos honourably distinguish themselves by condemning suicide. In general, however, ancient thought considered it a neutral act, quite at the option of each one, and virtuous or the reverse according to circumstances.

The prevalence of suicide is a somewhat remarkable feature of Chinese society, and the statistics of this crime in China are truly shocking. Opium is a favourite means of committing suicide, the average number of such cases being 160,000 annually. But the most extraordinary and terrible form that this practice takes is when parents destroy themselves in consequence of their son's misbehaviour. That this is by no means unusual, is shown by the existence of a law which imposes the worst form of death—namely, decapitation, upon the man who drives his parents to commit suicide. It follows that Chinese parents, by the threat of suicide, hold a formidable weapon over their son's head. The universal Chinese fatalism, combined with scepticism as to the future life, explains the matter as to China; and the reason why the still more fatalist teachings of the Mohammedans does not bear equally terrible fruit is no doubt due to their belief in heaven and hell.

Finally, what is the cure for this terrible evil which dogs the footsteps of intellectual progress? It is indicated most clearly by the favourable position of England in these melancholy statistics—a position no doubt due to the greater force and stability of her national character, both cause and consequence of the political freedom which she enjoys. Suicide augments with war, famine, and revolution, as is shown by the leaps in France and Prussia, especially in the 1870 period; it decreases with peace, prosperity, and permanent government. In face of a firm moral character it vanishes utterly away. We feel with Brutus ("Julius Cæsar," v. 1),

"I do find it cowardly and vile,
For fear of what might fall, so to prevent
The time of life."

Massinger and Milton follow Shakespeare in emphasizing the cowardice of suicide; but perhaps Sir Thomas Browne puts it most pithily in his "Religio Medici" (1642), when he says, "Suicide is not to fear death, but yet to be afraid of life." Yet probably fully as many live because they are afraid to die as die because they are afraid to live. Carlyle has settled the question once and for all for thinking men in the magnificent chapter of "Sartor Resartus," entitled the "Everlasting *No*." It is curious, however, that no direct prohibition of the crime exists in the Bible. The "canon 'gainst self-slaughter," which holds back Hamlet's self-murderous hand, is imaginary. Shakespeare doubtless had in his mind the famous canon on the subject passed by the Council of Trent. In "Cymbeline" (iii. 4), Imogen uses precisely the same terms as to a "prohibition so divine against self-slaughter that cravens my weak hand."

The vexed question as to the possibility of the suicide of animals must for the present be decided in the negative, notwithstanding several remarkable cases of apparent suicide.

Among the best recent works on the subject are those by Morselli ("International Scientific Series," London,

1881), and by W. Wynn Westcott, deputy coroner for Middlesex (London, 1885).

SU'ICIDE, in law, is the death of a person caused by his own act, voluntary or involuntary. Voluntary suicide, by the law of England, is a crime; and every suicide is presumed to be voluntary until the contrary is made apparent. This crime is called Self-murder and *felonia de se* ("self-felony"). A *felo de se* ("self-felon") is a person who, being of years of discretion and in his senses, destroys his own life, either intending to do so, or intending to do some other act of a character both unlawful and malicious; as if, in attempting to kill another, under circumstances which would have rendered such killing either murder or manslaughter, a gun bursts in the assailant's own hand, or he runs upon a knife casually in the hand of the person whom he intended to kill. So also if two persons agree to commit suicide together, and only one succeeds, the survivor is guilty of murder, as in the test-cases, R. *v.* Russell, and R. *v.* Alison. Also if, as in R. *v.* Gathercole (1839), one try to commit suicide and another is killed in endeavouring to save him, the would-be suicide is guilty of murder. Gathercole was actually so convicted. Also, any one aiding a person to commit suicide is guilty of murder, as in the case of R. *v.* May (1872). But in no case is self-felony considered to be committed if death do not ensue within a year and a day of the blow or injury; or in other words, if a whole year intervene between the day on which the blow, &c., is given, and the day on which death takes place.

The legal effect of a self-felony was at one time a forfeiture to the crown of all the personal property which the party had at the time when he committed the act, including debts due to him; but though the crime is called felony, it was never attended with forfeiture of freehold, and never worked any corruption of blood. Forfeitures for this and all other felony were abolished by the Act of 1870.

The fact that a self-felony has been committed is ascertained by an inquest taken before the coroner or other officer who has authority to hold inquests, upon view of the dead body. [See CORONER.] When a self felony was found by the inquisition, the jury were formerly required to inquire and find whether the party had any, and if any what, goods and chattels at the time when the felony was committed. The crown took the property of the self-felon subject to no liability in respect of his debts or engagements. Upon a memorial presented to the Treasury by a creditor of the deceased, a warrant under the sign-manual was, however, generally obtained, which authorized the ecclesiastical court to grant letters of administration to such creditor, who, upon such grant being made, acquired the ordinary rights, and became subject to the ordinary liabilities of a personal representative.

Involuntary suicide i[s] death occasioned by the act of the party, either without an actual intention of destroying life or of committing any other wilful malicious act, or without the legal capacity of intending to do so. Neither self-felony nor any other crime can be committed by a child who has not attained years of discretion; nor can it be committed by a person who, by disease or otherwise, has lost, or has been prevented from acquiring, the faculty of discerning right from wrong.

At common law, which in this respect follows the canon law, a person found by inquest to be *felo de se* is considered as having died in mortal sin; and his remains were formerly interred in the public highway without the rites of Christian burial, and a stake was driven through the body: but this ceremony was abolished by 4 Geo. IV. c. 52, by permission of which a *felo de se* is buried in a churchyard or other place where he might have been buried if he had not been a *felo de se*; but on condition that the interment must take place within the hours of nine and twelve at night, without any of the rites of Christian burial. This last restriction was abolished by the Act of 1870, which allows either a silent burial or a religious service as preferred. Dishonouring treatment of suicides was unknown in Scotland, though vulgar prejudices occasionally interfered with the mode of entry to the churchyard or burying-ground. No coroner's inquest is held on such cases; but wherever there exist circumstances of suspicion, these are investigated by the sheriff and his fiscals and reported to the lord advocate and his counsels.

The natural result of these harsh rules has followed. No one is now declared *felo de se*; and the conventional verdict usually records death by self-inflicted injuries during an attack of temporary insanity. As an insane person cannot commit a crime, the various penalties of suicide are thus avoided, and great grief to the survivors is spared.

As a rule life insurances are not paid if the suicide held the policy himself; but are paid if he had assigned the policy to another person. There is no distinct ruling as yet upon the subject.

SU'IDÆ. See PIG.

SUI'DAS, the author of the lexicon known by his name, lived probably in the tenth or eleventh century after Christ. The lexicon is arranged in alphabetical order, and contains a miscellaneous account of words, persons, and places. It is very badly planned, and its original faults have been greatly increased by numerous interpolations. The work, however, with all its defects is valuable, as containing a great amount of literary information not elsewhere accessible. Many important extracts and quotations from authors whose works have perished are to be found in the ponderous tomes of Suidas. The author is by some supposed to have been a Christian, but this is very uncertain, as the passages which favour this view may be interpolations. The standard edition is that by Dr Gaisford (three vols., Oxford, 1834).

SUIR, a river of Ireland, which rises in Tipperary, and flows from the mountain border, north-west side, to its south-east angle, where it is deflected east by the Galtee Mountains, and flows east into the head of Waterford Haven, between the counties of Kilkenny and Waterford. It is navigable for barges to Clonmel, and for vessels of 500 tons to Waterford, and has a length of course of 100 miles.

SUIT, a legal term used in different senses, and formerly applied to cases which went before the court of Chancery. The word *secta*, which is the Latin form, is from *sequor*, to follow; and hence a suit, in the sense of litigation, was a proceeding by which any legal or equitable right was pursued or sought to be enforced in a court of justice. Prior to the passing of the Judicature Act of 1873 litigious proceedings were known under many names. There were common law "actions," chancery "suits," "causes," and "petitions," admiralty "causes," divorce and probate "petitions," and divers other varieties. The same Act, however, which welded the various courts into one High Court of Justice, and vested in each division of it the equity jurisdiction formerly confined to Chancery, also abolished the various distinctive names of proceedings. Whatever the nature of the case, it must now be instituted in the High Court by a proceeding called an "action;" and every action must be commenced by a writ of summons, indorsed with a statement of the claim made and the relief sought. Parties to an action in the Chancery division are still frequently referred to as the "suitors," but in the High Court "suits" are now no longer known.

SUITE, the name of a famous musical form now rarely used. In one sense it was the parent of the sonata (and symphony), or perhaps more accurately the suite and sonata arose together, speedily to diverge along rapidly widening paths. The one remained a *suite de pièces*, a collection of pieces of dance music preceded by a prelude; and the other, while not forfeiting its title of *sonata*, that is, a piece of

instrumental music (in contradistinction to the *cantata* or piece of vocal music), developed into a grand form of contrasted movements, full of wide-ranging and subtle harmonies of key, of tone colour, and of sentiment. Now, the movements of the suite, properly speaking, should be all on one plan, and all in one key: they differ only in rhythm and sentiment. The *Prelude* is of course free in form, and the *Aria*, which often occurs before the final *Gigue*, is in original examples on the lines of the familiar Handelian solo, a type due to Alessandro Scarlatti. The other movements form the suite proper, and they are all dance tunes of the simplest form, each with its formal first part and second part; scarcely more elaborate, though far more beautiful, than the tunes actually danced to at the time. Their order in the best examples is *Allemande*, *Courante*, *Sarabande*, and *Gigue*. The position of the prelude and aria has already been given. Besides the aria, the minuet, gavotte, bourree and musette, and other forms were inserted before the gigue; sometimes one, sometimes the other, and occasionally two of them or more. Most of Handel's fine suites are in this order, and so are Bach's partitas. Partita is merely another name for suite, and Ordre is yet another, but the latter is somewhat unusual.

The allemande is a slow undulatory movement in duple time with never-ceasing even semiquavers, one part imitating another without break. Contrasted with this is the courante in triple time, and with syncopated and broken rhythm, moving quickly and with brightness. The sarabande is a definitely slow movement in triple time, with a strongly marked rhythm, the first two beats always prominent, the third often absent. A sweeping and majestic flow of melody and harmony marks this stately movement. The finest example of the sarabande is that which Handel afterwards used again as an air in Rinaldo: "Lascia ch'io pianga." Finally, the gigue, gay and rattling in style, usually taken presto, always in some triple time, winds up the suite in brilliant fashion.

Some modern composers have used the suite form, and have produced excellent modernizations of it. Raff, Lachner, Tschaikowsky, and Cowen are examples; and Sullivan's highly successful "Ouvertura di Ballo" is practically a variety of the suite, for it is in dance rhythms from one end to the other.

SU'LEIMAN or **SOLYMAN MOUNTAINS**, a forest-clad range of mountains, of secondary formation, forming the N.W. boundary of the British possessions in India. They descend steeply towards the Indus, and decline gradually towards the desert plateau of East Afghanistan or Seistan. Their culminating point is Takht-i-Suliman, or Solomon's Seat, lat. 31° 35′, 11,300 feet, which is under the snow-line. About lat. 29° 30′ a cross range, called the Gendaree Mountains, connects them with the Hala range of Eastern Baluchistan, which extends to the sea-coast near Kurachee. On the north they are connected with the Sufeid-Koh, East Ghuznee; whole length, 350 miles. They give origin to many streams, but none of these reach the sea in any direction except the Kurum, which joins the Indus below Kalabagh. They are not properly a chain, but a succession of irregularly parallel ranges, running down from the Iran table-land east and south-east, and presenting bold terminations towards India.

SU'LEIMAN (Sultan). See SOLIMAN.

SULI'NA is the name given to that one of the seven mouths of the Danube which forms the best commercial harbour. The completion of works in 1872 increased the depth to 20 feet on the bar. See DANUBE.

SU'LIOTS, a people of mixed Albanian and Greek descent, who formerly dwelt in the southern part of the pashalik of Janina, the ancient *Epirus*. They derive their origin from a number of families who in the seventeenth century fled from the tyranny of the Turks and took possession of the ridge of the Suli Mountains and the valleys on both sides of it. In the second half of the eighteenth century the population numbered about 10,000, half Parasuliots (subjugated people of different origin), and dwelt in seventy villages, Kako-Suli, 1200 feet above the river Acheron, being the chief. Near this village they erected the castle of Suli on a semilunar mountain, which terminated in so narrow a ridge as hardly to leave a path from one fortification to another. The Suliots belonged to the Greek Church, and their language was Albanian, although they also spoke Greek; their form of government was a mixture of oligarchy and democracy. They were divided into about thirty tribes or clans. In war they usually fought as skirmishers, each clan having its captain, subject to an officer called *polemarch*, who was elected by vote. In the war of 1787–92 between Russia and Turkey, the Suliots strongly supported the former power, defeated in 1789 the troops of Ali Pasha of Janina, ravaged Acarnania to the Achelous in 1790, and afterwards invaded Arta and Janina, and aided the corsair Lambro Canzani with men and money. Deserted by the Russians after the peace of 1792, they fought desperately and successfully against the troops of Ali Pasha, who sought to exterminate them, and secured a truce for a few years. But in May, 1801, Ali renewed the war and put large numbers to the sword; the women threw themselves into the river rather than be captured. Most of the survivors, about 4000, in 1803 retired to Parga. Compelled by Ali to leave this place, they went to the Ionian Islands. Many afterwards enlisted in the Greek regiments raised by the English during the war, which were disbanded in 1814. When in 1820 Ali Pasha, in revolt against the Porte, was hard pressed by the Turks under Kurshid Pasha, and deserted by the Albanians, he recalled the Suliots. The tyrant of Janina fell in 1822, but the Suliots remained hostile to the Porte, adhering to the cause of Grecian liberty. In spite of the heroic efforts of their leader, Marco Bozzaris, the Suliots were hemmed in in their inaccessible valley; and at last, Suli being taken, 4th September, 1822, they accepted the offer of an asylum from the governor of the Ionian Islands. About 2000 were carried in English ships to Cephalonia, the remainder dispersing among the mountains.

SUL'LA, the name of a patrician Roman family of the great Cornelian gens, which included the Scipios and other famous families among its ranks. The Cornelius Sulla family was originally called Rufinus, and its most illustrious member was *Lucius Cornelius Sulla Felix*, the famous dictator, who was born 138 B.C. Although his means were limited, he received a good education, was a proficient both in Greek and Roman literature, and was at an early age distinguished by his love of literature and of art. He was at the same time a leader among the fashionable young nobles of Rome, was the companion of actors and buffoons, and openly indulged in all kinds of debauchery. His original slender patrimony was increased by the bequests of his step-mother and of Nicopolis, one of his mistresses, who left him all their property. His fortune thus improved, he now became a competitor for public influence and honour, and in 107 B.C. was appointed quæstor, and served under Marius in the Jugurthan War. Although he was at first regarded with distrust as an effeminate profligate, he soon gained both the confidence of his general and the affection of his soldiers. He commanded the horse in the battle of Cirta, and greatly contributed to the victory which the Roman army gained over Bocchus and Jugurtha. By his dexterity and duplicity he induced the Numidian king to betray his ally, and treacherously to deliver Jugurtha into the hands of the Romans. Sulla was exceedingly proud of this exploit, which reflected much more credit upon his cunning than upon his principles; and he caused a seal ring to be engraved representing the surrender of Jugurtha, which he continued to wear till his death. In the war against the Cimbri and Teutones (104 B.C.)

Sulla served under Marius as his legate, and made prisoner Copillus, a chieftain of the Tectosagæ. In the following year he acted as military tribune, but in 102 he left Marius and joined the army of his colleague Lutatius Catulus; either, as Plutarch alleges, through the jealousy of Marius, who feared that his own fame might be eclipsed by that of his tribune, or, as others suppose, owing to the belief of Sulla that he could be much more useful under Catulus, whose military talents were not of a high order. At the close of the war against the Alpine tribes, which he conducted with great success, Sulla returned to Rome, where for several years he spent his time in licentious indulgences. In the year 94 B.C. he was an unsuccessful candidate for the prætorship, but in the following year he carried his election by a wholesale bribery of the people. In 92 B.C he was sent as proprætor to Cilicia, with orders to restore Ariobarzanes to his kingdom of Cappadocia, from which he had been expelled by Mithradates an enterprise in which he met with complete success. The rivalry between Marius and Sulla, or rather between the two great parties of which they were the respective leaders, now became very conspicuous, and a violent contest began for the command of the impending war against Mithradates; but open hostilities were for a time delayed by the outbreak of the Social War, which for several years convulsed Italy. Sulla acquired great distinction by his brilliant exploits in this contest, and left no means untried to gain the goodwill of his soldiers, conniving even at their worst excesses. He was elected consul for the year 88 B.C., and obtained from the senate command of the Mithradatic War. But before he could set out on this enterprise, Marius, alarmed for his own pre-eminence in public affairs, with the help of the tribune, P. Sulpicius, brought about a revolution in Rome, expelled Sulla from the city, and deprived him of the command of the war. But when this decree was made known to his soldiers, who were strongly attached to their general, they mutinied, and clamoured loudly to be led to Rome. Sulla, nothing loth, put himself at the head of six legions. with the declaration that he was going to deliver the capital from its tyrants, and, marching against the city, took it by storm. A battle followed within the walls, in which Sulla was victorious. Marius fled for his life, leaving his adherents to be proscribed and put to death, and their property confiscated by his victorious rival. Having crushed his opponents, and made several changes in the constitution to render it more favourable to the aristocratic party, Sulla set out for Greece at the beginning of 87. He landed at Dyrrachium (Durrhachion), and marched upon Athens, which Archelaos, the general of Mithradates, occupied with a powerful army. After a long and desperate resistance Athens was taken by storm (1st March, 86), given up to plunder, and many of its most magnificent buildings and works of art destroyed. Sulla then marched against Archelaos, who had meanwhile received lar[illegible] reinforcements from Asia, and defeated him first at Chairôneia (86 B.C.), and then at Orchomenos in Bœotia (85 B.C.) He next crossed the Hellespont; but instead of driving Mithradates to extremities he concluded a peace with that monarch (84 B.C.), and in order to secure the attachment of his soldiers, levied for their benefit heavy contributions on the unfortunate inhabitants of the country, whom he treated with great injustice and severity. The events which had taken place in Rome during his absence made him anxious to put an end to the war as speedily as possible. Sulla was an aristocrat of aristocrats; pledged above all things to the restoration of the senatorial patrician oligarchy. The popular or democratic party had regained the ascendency, and having crushed his supporters, had abolished his institutions, confiscated his property, and declared him an enemy of the republic. Having settled affairs in Asia, Sulla prepared to return to the assistance of his friends in Italy. Taking with him about 30,000 men he set sail from Ephesos, and after a voyage of three days reached Athens. Here he secured the valuable library of Apellikôn of Teôs, and carried it with him to Rome. He landed at Brundusium in the spring of 83 B.C.; and though the troops of the popular party far outnumbered his, partly by bribes and promises, partly by his own energetic efforts and the assistance of Pompey and other influential nobles, he was able to make head successfully against his antagonists. He defeated the consul Narbanus near Capua; young Marius at Sacriportus; and the Samnites and Lucanians in a great battle at the Colline gate of Rome (82 B.C.), in which 50,000 are said to have fallen. Sulla tarnished his victory by putting to death several thousands of his prisoners. The surrender of Præneste, the slaughter of its defenders, amounting to 12,000, and the suicide of the younger Marius, speedily followed. Sulla was now absolute master of Rome and Italy, and he resolved to secure his ascendency by extirpating the popular party. He drew up a list of those who were to be put to death, and their property confiscated (the first example of a proscription in Roman history); declared them outlaws, who might be slain by any one, even by slaves, with impunity; excluded their children and grand-children from the right of voting in the comitia, and from all public offices; offered a large reward to those who killed, and denounced the punishment of death against those who sheltered, a proscribed person. Nor was the vengeance of Sulla confined to the city. All the Italians who had in any way favoured the defeated party were in like manner punished by death and confiscation. Many thousands perished, and the terror-stricken citizens submitted in silence to the changes which Sulla, who had been appointed dictator, now effected in the constitution. It is most remarkable to think that had Sulla died when he was fifty and Marius when he was sixty neither one nor the other would have excited the shuddering awe we now feel at their bloodstained names. The victorious Sulla's object was to abrogate all the liberal measures of the preceding fifty years; to prevent the enfranchisement of the Italians, the agrarian distributions, and the plantation of colonies; to destroy the authority of the tribunes of the people; to abolish the legislative and judicial functions of the comitia tributa; in short to restore to the senate and the aristocracy the power of which they had been deprived. His uniform success obtained for him the surname of Felix (the Prosperous), and having held the dictatorship till the beginning of 79, and seen his constitutional reforms accomplished, he resigned this office and retired into private life. He took up his residence at his villa, near Puteoli, where he passed his time partly in literary pursuits, partly in licentious indulgences, to which he had always been strongly addicted. His last days were harassed by the loathsome disease called phthiriasis, and he died in 78 B.C. in his sixtieth year. He was four times married.

Sulla is one of the most interesting figures in all the splendidly interesting pages of Roman history. The partial mystery surrounding much of his uniformly successful career has somewhat to do with this. His was an age of memoir writing: he was himself an elegant scholar and writer, and left an autobiography which seems to have been as fine in its way as the Commentaries of Cæsar. All his chief contemporaries wrote memoirs, save Marius; and plenteous memoirs were written of Marius, though none by him. Yet all these writings have perished, and we know the times of Sulla only through Plutarch and Appian, two Greeks, the first of whom wrote as late as Nero's time and Hadrian's, and the other in the next century after that. The lost works of Sallust, almost a contemporary of Sulla, and the lost books of Livy on these times, are among the standing griefs of lovers of history.

The interest of this remarkable character lies in its pure-

patriotism. An indolent voluptuary, addicted to every pleasure of the senses, including all that is noble and refined, artistic and scholarly, as well as the coarse satisfaction of the animal appetites, Sulla gave up his cherished leisure to encounter every danger and hardship for no selfish purpose at all, but purely to benefit his country by restoring to it what he thought was the origin of her greatness—the rule of the aristocracy. We must hold him fearfully, criminally wrong; but we cannot refuse him a certain admiration. In his determination to restore the power of the senatorial oligarchy he stuck at nothing. He found the municipal system of Rome a failure when applied to the government of the world. Laws were passed affecting all Europe by a hungry venal mob of that mixture of the worst of many various races which crowded into Rome and formed its "citizens." Marius, his great rival and the leader of the democratic party, was the first to enlist such men as soldiers; before him every one who was allowed to bear arms had to have a stake in the state. Sulla showed his contempt for such "citizens" by enfranchising no less than 10,000 slaves set at liberty during his proscriptions, and forming them into a fresh Cornelian gens. He initiated the fearful custom of proscription, but from policy, not through love of cruelty. Not one sufferer under Sulla was tortured, nor did the horrors due to Sulla arise from a mad desire for vengeance such as disgraced old Marius. His aim was to root out the democratic party by destroying every member of it so far as he could. Cæsar himself only escaped by a mere chance. The list of proscribed included fifteen consuls or consulars, ninety senators, 2600 knights, and as many more untitled persons; and it has been computed that of ordinary men 100,000 fell under the proscriptions and in the wars for which Sulla was responsible. Yet this man, who never spared nor forgave, died in his bed, while Cæsar, always merciful and readily forgiving, died by the daggers of those whom he had forgiven. When Sulla had accomplished the revision of the constitution on a strictly aristocratic basis he laid down his office, and he on whose soul 100,000 lives lay walked to his house unattended by a single lictor. In everything Sulla was fortunate (*felix*); for even with all his terrible destructiveness he gained public affection. This paradox is a simple truth, and serves to prove how little we really know of Sulla's true motives. His genuine popularity cannot be better shown than by the scenes at his funeral.

The news of his death awakened throughout Italy, almost without exception, a feeling of deep and universal sorrow. We hear nothing of an outburst of pent-up joy, such as has been often manifested on the death of cruel tyrants by nations cowed into submission by fear. Not only his numerous friends, adherents, and clients, but the whole Senate and people, knights, citizens, and peasants, the capital and all Italy seemed to feel that a man had gone from them to whom the republic owed almost its existence and the hope of a prosperous future. It was in vain that the consul Lepidus attempted to deprive the deceased dictator of the honour of a solemn public funeral. He found it necessary to yield to the unanimous desire of his colleague Catulus, of Pompey and Lucullus, and the prevailing popular sentiment. The body was placed on a gilt bier, decked with all but royal pomp, and the insignia of the high office which the deceased had discharged. Thus it was carried in slow procession all the way from Campania to Rome. As it moved along the old soldiers put on their disused armour, and converging from all directions fell into rank and file, following their dead general like an army on the march. The people joined them in crowds, swelling the enormous train more and more as it approached the capital. Never had living general celebrated so grand a triumphal entry into Rome as the dead Sulla. Before him were carried more than 2000 golden crowns, the honorary gifts of municipalities, legions, and individual citizens. The senators took the body upon their shoulders and bore it to be burnt on the field of Mars, where up to this time none but kings had been buried. The legions moved round the funeral pile in military order, as if they had wished that, while the body of their adored leader was crumbling into ashes, his spirit should once more pass them in review.

SULLY, MAXIMILIAN DE BETHUNE DE ROSNY, DUC DE, the celebrated French statesman, was born at Rosny, near Mantes, 13th December, 1560. The family of Bethune was ancient and noble, descended from the Coucis, and through them, as Sully himself informs us, with the pride which was one of the few weaknesses of his noble character, from the first emperors of Austria. Maximilian's elder brother, Louis, having infirmities which rendered hopeless his success in the world, their father paid double attention to his second son, and placed him under the care of a celebrated preceptor named La Brosse, who instructed him in all the learning of the time. The seed fell in good ground, for the boy's intellect was strong and his temperament energetic; while the tenets of the Huguenots, which were early instilled into him, contributed largely to mould his mind and to influence his future career. In 1572 he was taken by his father to the court of Henry, the king of Navarre, at Vendôme. Young Rosny being received into that prince's service, afterwards accompanied him to Paris. The future Sully was then only eleven years of age; the future Henry IV. about nineteen. It was the commencement of one of the most memorable friendships recorded in history. The same year Rosny escaped destruction at the massacre of St. Bartholomew only through the friendly aid of the principal of the college where he was prosecuting his studies. He continued to reside at Paris in a condition of precarious freedom, and for some years assiduously devoted himself to the cultivation of his mind. But at the age of fifteen his studies were suddenly interrupted, and he was plunged into all the cares and turmoil of active life. It was then, in the beginning of 1575, that Henry effected his escape from the continement in which he was kept by the French court, and the faithful Rosny fled along with his royal master. In the desultory hostilities which ensued the young student learned to be a soldier; and during the protracted period of the civil war, broken but now and then by brief and hollow truces, his peculiar genius found full scope for its development. It was those nineteen years of tempest, from 1575 to 1594, that roughly yet completely trained the future prime minister of France. The zeal which Rosny showed for Henry's cause, and his devotion to his person, were appreciated by the latter. At the age of twenty he made his young follower a councillor of Navarre, with a salary of 2000 livres. In 1583 Rosny, whose father had died some years previously, married Anne de Courtenay, and spent a brief period in comparative retirement. But in 1585 he again rejoined his master, and became his most valued and confidential adviser. In the field also he was a brave and successful soldier. He assisted at the battle of Coutras in 1587, where Joyeuse was slain and Henry gained a glorious victory. The artillery, of which Rosny had the command, was mainly instrumental in this success. The battles of Arque and Ivry followed, the latter of which, in 1590, was so signal a triumph for Henry's cause. At Ivry Rosny was dangerously wounded. Notwithstanding these successes, it having become apparent that no Protestant could hope to obtain secure possession of the French throne, Rosny, on being consulted by Henry as to the propriety of his change of religion, advised him to embrace the Roman Catholic faith. Yet in justice to the inflexible honesty of the adviser, let us remember that patriotism was with that adviser a master-principle, and that he saw no other way of restoring peace to his distracted country than the course he thus recommended to his sovereign. Neither let it be forgotten that, although often and sorely

tempted, he would never himself consent to surrender the Huguenot creed professed by him from his earliest years. Henry abjured the reformed faith at St. Denis in July, 1593, and the following year he entered in triumph the capital of France. After his accession to supreme power he wisely, in 1596, made Rosny a member of the great council of finance, where the efforts of the latter to introduce order and economy into all matters connected with the revenue of the kingdom were in the end crowned with the most satisfactory results. Promoted ere long to be superintendent of the finances, he discharged the duties of his important office with characteristic zeal, integrity, and energy; the treasury, so wretchedly poor before, was amply replenished; while at the same time the people found their burdens lightened by the economical courses which Rosny recommended and adopted. It is sufficient to say that when, in 1597, he was appointed financial minister the treasury was empty and in debt; at the death of Henry, in 1610, it contained 42,000,000 livres. To the industry of the people Rosny ever looked as the great source of national wealth, and to their welfare as one, at least, of the great ends of government. Keeping these objects systematically in view, he was, as a statesman, one of the truest benefactors of his country. Honours and emoluments formed his well-merited reward. He became grand master of the ordnance and surveyor-general of public works—in fact, sole minister of the realm; was sent in 1603 ambassador to the English monarch on his accession; and in 1606 was created Duc de Sully and a peer of France. After Henry's assassination Sully resigned the cares of office, and withdrew to his estates, where he spent the remainder of his life in rational and dignified, but not inactive, retirement. It was during this period that he composed his "Memoirs," which give such interesting details of his own life and that of the royal master whom he had so long and so faithfully served. After thirty years thus spent in comparative tranquillity he expired at the chateau of Villebon on the 22nd of December, 1641, in the eighty-second year of his age. "Sully was in the cabinet," justly remarks one of his biographers, "what Bayard was in the field, a chevalier without stain; he represents the order of gentlemen in the gallery of statesmen." Inspired by uncompromising honesty and spotless honour he challenges our admiration as standing high among those rare ministers who refuse to sacrifice to the tortuous expediencies of the mere politician a single atom of dignity, of opinion, of religion. Yet although always conscientious and often stern and rough, Sully was no bigot: the indomitable Huguenot lived on friendly terms with the Catholics, with the Pope, with the Guises; and he could even unbend, when occasion called for it, into not ungraceful gaiety. He was pre-eminently a man of action, as is evident from his whole career, and from the character of the "Memoirs" already referred to. Like our own Cromwell, he seems to have had a difficulty in conveying his thoughts with brevity and intelligibility. Still, the large brain and the strong arm are apparent alike in his life and in his writings.

SULMO'NA or **SOLMONA,** a town in the south of Italy, is situated in a fertile plain 34 miles south-east of Aquila. It is walled, and looks old and gloomy. The city gives title to a bishop, and has about 18,000 inhabitants, a town-hall, a college, a clerical seminary, a cathedral, and numerous other churches, a foundling hospital, some paper mills, and manufactories of catgut, sugar-plums, and sausages. Two miles from the town is a magnificent Celestine monastery, now suppressed and used as a house of industry. The valley of Sulmona, which is intersected by several streams and irrigated by artificial canals, is productive of corn, wine, and oil. The ancient Sulmo, Ovid's birthplace, which stood at some distance from Sulmona, was one of the chief towns of the Peligni, a people of Sabine origin; there are now no traces of it.

SULPHACET'IC ACID, an acid obtained by the action of sulphuric anhydride on acetic acid. It crystallizes in deliquescent prisms, having the formula $C_2H_4SO_5$. These melt at 62° C. (143° Fahr.), and decompose at 200° C. (392° Fahr.) It is soluble in water, and is dibasic, forming a number of salts called sulphacetates, all of which, even the barium salt, are soluble in water. The general formula of these salts is $C_2H_2M_2SO_5$.

SULPHAN'IC ACID is only known in combination. The formula is NH_3SO_3. It forms crystalline salts called sulphanates, all of which are soluble in water. The sulphanate of ammonium ($N_2H_6SO_3$) is obtained by passing dry ammonia gas over sulphuric anhydride. There is also an acid sulphanate of ammonium, having the formula $N_2H_6SO_3NH_3SO_3$. Sulphanic ether (CH_5NSO_3) is a deliquescent crystalline body.

SULPHANIL'IC ACID is obtained by the action of sulphuric acid on aniline. It crystallizes in rhombic plates, having the formula $C_6H_7NSO_3H_2O$. It is soluble in water, but insoluble in alcohol and ether. It forms crystalline salts, soluble in water, and having the general formula $C_6H_6MNSO_3$. Bromine converts this acid into dibromo-sulphanilic acid ($C_6H_5Br_2NSO_3$), a crystalline acid which also forms crystalline soluble salts called dibromo-sulphanilates, and having the general formula $C_6H_4MBr_2NSO_3$. By heating sulphanilic acid with fuming sulphuric acid disulphanilic acid ($C_6H_7NS_2O_6$) is formed, which does not crystallize. The disulphanilates are soluble crystalline salts, having the general formula $C_6H_5MMS_2O_6$.

SUL'PHATES. See SULPHUR.

SUL'PHO-BENZAM'IC ACID is obtained by heating sulpho-benzamide with potash. It crystallizes in rhombohedrons, soluble in hot water and in alcohol. The formula is $C_7H_7NSO_4$. It melts at 200° C. (392° Fahr.); at a higher temperature it volatilizes and burns with a luminous flame. It forms a number of crystalline salts called sulpho-benzamates, all of which are soluble in water, and have the general formula $C_7H_6MNSO_4$. Sulpho-benzamic ether, or ethylic sulpho-benzamate, $C_7H_6(C_2H_5)NSO_4$, crystallizes in needles, soluble in alcohol and ether. Sulpho-benzamide ($C_7H_8N_2SO_3$) crystallizes in needles, soluble in hot water and alcohol. Sulpho-benzide ($C_{12}H_{10}SO_2$) crystallizes in rhombic plates; it melts at 100° C. (212° Fahr.), and is soluble in alcohol and ether.

SUL'PHO-BENZO'IC ACID ($C_7H_6SO_5$), an acid obtained by the action of benzoic acid on sulphuric anhydride. It is deliquescent, crystalline, and dibasic, forming acid and neutral salts called sulpho-benzoates, respectively $C_7H_5MSO_5$ and $C_7H_4M_2SO_5$. Some of these salts form large and beautiful crystals. The action of nitric acid produces nitro-sulpho-benzoic acid, $C_7H_5(NO_2)SO_5$, a crystalline acid forming crystalline salts called nitro-sulpho-benzoates, having the general formula $C_7H_4M(NO_2)SO_5$. Sulpho-benzoic ether, or ethylic sulpho-benzoate, $C_7H_4(C_2H_5)_2SO_5$, is a syrupy liquid, soluble in water, which cannot be distilled without decomposition.

SUL'PHO-CARBAM'IC ACID. The ammonium salt of this acid is obtained by the combination of ammonia with disulphide of carbon. By decomposing this salt with dilute sulphuric acid, sulpho-carbamic acid is obtained as a reddish oil, heavier than water, and having a very disagreeable odour. It is rather unstable, and easily decomposed into sulphocyanic acid and sulphuretted hydrogen. The formula is CH_3NS_2; that of the ammonium salt is $CH_2(NH_4)NS_2$. It crystallizes in yellow prisms soluble in water. There are several ethers of sulpho-carbamic acid; the principal one is ethylic oxy-sulpho-carbamate or xanthamide (C_3H_7NSO). It crystallizes in octahedrons, which melt at 36° C. (96° Fahr.), and are soluble in alcohol and ether. Distillation decomposes it into mercaptan (C_2H_6S) and cyanic acid (COHN). It forms double salts with many of the metallic salts.

SUL'PHO-CARBON'IC ACID. This acid is obtained from sulpho-carbonates by decomposition with hydrochloric acid. It is a yellow oily liquid, having the formula H_2CS_3. The sulpho-carbonates are analogous to the carbonates, and have the general formula M_2CS_3. These are formed by the direct union of disulphide of carbon with a metallic sulphide. The alkaline salts are yellow compounds, soluble in water. The metallic salts are insoluble. The alkaline salts are decomposed by boiling the solutions, sulphuretted hydrogen being evolved and a carbonate of the alkali formed. This acid forms a large series of ethers, and a considerable number of derivatives from these. The most important is ethyl disulpho-carbonic acid or xanthic acid, $C_3H_6OS_2$ or $(C_2H_5)HCOS_2$. This is a colourless oil heavier than water, and very inflammable. Boiling decomposes it into alcohol and disulphide of carbon. It forms a number of crystalline salts called xanthates. Xanthate of potassium crystallizes in colourless needles, having the formula $(C_2H_5)KCOS_2$. The xanthates of the metals are mostly insoluble. Xanthic ether, or ethylic disulpho-carbonate $(C_5H_{10}OSO_2)$, is a sweet-tasting yellow liquid having a specific gravity of 1·0703, and boiling at 200° C. (392° Fahr.) It is insoluble in water, but soluble in alcohol and ether.

SUL'PHO-CINNAM'IC ACID is obtained by the action of fuming sulphuric acid on cinnamic acid. It crystallizes in prisms, having the formula $C_9H_8SO_5 3H_2O$. It is soluble in water and alcohol. The acid is dibasic, and yields two series of salts, acid and neutral, and called sulpho-cinnamates. These are generally crystalline, and soluble in water. The formula of the acid salts is $C_9H_7MSO_5$; that of the neutral salts is $C_9H_6M_2SO_5$.

SUL'PHO-CYAN'IC ACID. This acid occurs in the form of sulpho-cyanate of potassium or sodium in human saliva and in that of the sheep; it is also found in water distilled from horse radish and mustard. When anhydrous it is a colourless liquid, which freezes in six-sided prisms at 12·5° C. (54° Fahr.) It boils at 85° C. (185° Fahr.) with a pungent odour resembling acetic acid. The formula is CNHS. It is very soluble in water, but the solution rapidly decomposes, especially when heated, into carbonic acid, disulphide of carbon, and ammonia, according to the following equation:—

$$2CSHN + 2H_2O = CO_2 + CS_2 + 2NH_3.$$

Sulphocyanate of potassium (CNKS) is prepared by fusing ferrocyanide of potassium with sulphur, and dissolving out the salt with alcohol. It crystallizes in anhydrous deliquescent prisms. The crystals are very soluble in water and alcohol, and very poisonous. The solution, when boiled, decomposes with evolution of ammonia. The sulphocyanates are characterized by producing a deep blood-red colour with solutions of ferric salts; the reaction is very delicate, and forms an excellent test for minute traces of iron. With platinum two series of double salts, called sulphocyano-platinites and sulphocyano-platinates are produced. These are all coloured salts, from yellow to deep red, and resemble the chloro-platinites and chloro-platinates.

Sulphocyanic anhydride (C_2NS) or cyanic sulphide crystallizes in rhombic tables, soluble in water, alcohol, and ether. The crystals melt at 40° C. (104° Fahr.), and sublime unchanged.

Sulphocyanic ether or ethylic sulphocyanate, $CN(C_2H_5)S$, is a colourless liquid of disagreeable odour, and insoluble in water. The specific gravity is 1·020; the boiling point is 146° C. (284° Fahr.) There are several other sulphocyanic ethers. The most important is allylic sulphocyanate, $CN(C_3H_5)S$. This body is known as volatile oil of mustard, and is obtained from mustard seed by distillation with water. It does not exist ready formed in the seed, but is produced by the action of myrosin on myronic acid, both of which are contained in the seed, and it can also be obtained artificially. It is a colourless pungent oil, exciting tears and blistering the skin. The specific gravity is 1·015; the boiling point is 148° (298° Fahr.) It is insoluble in water, but soluble in alcohol and ether. Sulphosinapic acid ($C_4H_7NS_2$) forms salts, which are combinations of allylic sulphocyanate with metallic sulphydrates. This acid forms a number of crystalline salts, but it is not known in the free state.

SUL'PHO-SALICYL'IC ACID is obtained by the action of sulphuric anhydride on salicylic acid. It crystallizes in needles, soluble in water, alcohol, and ether. The formula is $C_7H_6SO_6$. It is a very strong dibasic acid, and forms neutral and acid salts, having the general formula $C_7H_4M_2SO_6$ and $C_7H_5MSO_6$ respectively. All the salts are soluble in water, and insoluble in alcohol and ether. They give a deep violet colour with ferric salts.

SUL'PHUR, commonly called *Brimstone*, is an elementary non-metallic body, which has been known from the earliest times. It is found native in a pure state, and in combination with various metals it forms some of the principal metallic ores; and in the form of sulphates of the alkalies and alkaline earths it is very widely diffused. In Sicily, in Iceland, and in Mexico it is found in a pure state in crystalline yellow masses, and also in the lava of volcanoes. As a sulphide it is found in combination with iron as iron pyrites, with copper as copper pyrites, with lead as galena, with mercury as cinnabar, with antimony as gray antimony, and with arsenic as realgar. As a sulphate it is found combined with calcium as gypsum, with barium as heavy spar, and with strontium as celestin. Also with magnesium and with sodium as sulphate it is found native. Both these salts are common ingredients of mineral water, to which they contribute the aperient properties. As sulphydric acid it is present in the Harrogate mineral waters. It is also present in albumen, taurin, cystin, and other products of animal origin. It is also an important constituent of certain plants, especially those belonging to the natural order Cruciferæ, as the mustard, cabbage, and turnip.

The native sulphur is roughly purified in Sicily and Italy by fusion or distillation in earthen pots. The crude sulphur thus obtained is imported into this country and again refined by distilling it in a large iron pot; the vapour is condensed in a spacious brick chamber in a fine pulverulent form, known as flowers of sulphur, or in a liquid state in a small receiver. It is then run into moulds made of sycamore wood, and is known as roll sulphur. As the former process requires more time, it is more general to run the sulphur into lumps and powder it to form the flowers of sulphur. This form of sulphur, however, is not suitable for dressing vines, and for this purpose it must be collected in impalpable powder. It is also obtained by roasting copper and iron pyrites and condensing the sulphur; but these ores are more commonly employed for the manufacture of sulphuric acid or oil of vitriol.

Milk of sulphur, as employed in medicine, is obtained by precipitating a soluble sulphide with hydrochloric acid. It is often adulterated with sulphate of lime. Sulphur is also obtained on the large scale by decomposing with an acid the crude calcium sulphide obtained from the vat waste from the alkali manufacture, but only part of the sulphur can be thus extracted. In some cases the sulphurous acid obtained by roasting the iron pyrites is employed for the precipitation, and the sulphur of the pyrites and that of the waste is obtained together. The sulphide of iron produced in the gas-works from the ferric oxide, used for purification, may also be employed in this process; it contains 40 to 50 per cent. of sulphur. Sulphur is a brittle, lemon-yellow solid body, tasteless, insoluble, and inodorous. It is a non-conductor of heat and electricity. On friction it becomes negatively electric. The specific

gravity is 2·05. It melts at 120° C. (248° Fahr.) into a clear yellow liquid; it boils at 440° C. (792° Fahr.), and forms an orange-coloured vapour. At 200° to 250° C. (392° to 482° Fahr.) it becomes dark and very viscid, so that it can scarcely be poured out; but at 250° to 300° C. (482° to 572° Fahr.) it again becomes liquid, and it goes through the same stages in cooling. If at 300° C. it is poured into cold water, it forms a brown plastic mass, which may be drawn out into fine elastic threads, and which is sometimes employed for taking impressions. It then has a specific gravity of 1·95, and is insoluble in disulphide of carbon, in which ordinary sulphur is very soluble. There are several other allotropic forms of sulphur. Ordinary sulphur crystallizes in octahedra, and also in oblique prisms (specific gravity 1·98), both of which are soluble in disulphide of carbon; precipitated sulphur or milk of sulphur is also soluble in this menstruum, but it is amorphous. Plastic sulphur and another precipitated variety are both insoluble.

Sulphur is very inflammable, and burns in the air with a pale blue flame, being converted into sulphurous acid (SO_2). The atomic weight of sulphur is 16, and its symbol S. It combines directly with most of the metals forming sulphides; some of these metals take fire spontaneously in its vapour, as copper and lead. Iron filings, mixed with sulphur and moistened with water, develop heat, and combine into ferrous sulphide. Caustic alkalies also dissolve sulphur, forming mixtures of sulphide and hyposulphite of the alkali. It is gradually dissolved also by strong nitric acid, being then oxidized to sulphuric acid. It is soluble in alcohol, ether, turpentine, chloroform, benzine, and some oils.

With chlorine it forms disulphide of chlorine or protochloride of sulphur (Cl_2S_2), a yellow fuming liquid of disagreeable odour, having a specific gravity of 1·687, and boiling at 139° C. (282° Fahr.) It dissolves sulphur up to 66 per cent., and forms a dense liquid of specific gravity 1·7. This liquid is soluble in benzine, and the solution is employed for vulcanizing india-rubber.

A similar compound is formed with bromine (Br_2S_2). Tetrachloride of sulphur (SCl_4) is only known in combination. With iodine it forms iodide of sulphur (I_2S_2), a dark crystalline metallic mass.

With hydrogen, sulphur forms two compounds, the protosulphide (H_2S) and the persulphide (H_2S_2). The protosulphide is also known as hydrosulphuric acid, sulphydric acid, and sulphuretted hydrogen. It is usually prepared from sulphide of iron by acting on it with dilute sulphuric acid. It is found in some mineral waters, and is a common product of fermentation or decay of bodies containing sulphur. The offensive odour of rotten eggs is due to this compound. It is a gas heavier than atmospheric air and soluble in water; it liquefies into a thin colourless fluid, lighter than water, at a very low temperature, and at 85·5° C. (121° Fahr.) becomes a crystalline solid. It is extremely poisonous even when much diluted. It is inflammable—burning with a blue flame and forming sulphurous acid. The sulphur can be removed by metallic cadmium, an equal volume of hydrogen remaining. It is much used in the laboratory as a reagent in testing for metals in analysis, and also as a reducing or deoxidizing agent.

Persulphide of hydrogen is an unstable heavy oily liquid; it is obtained by gradually adding a solution of an alkaline sulphide to hydrochloric acid in excess. It is insoluble in water, but soluble in ether. The solutions decompose on standing into sulphydric acid and sulphur. It is inflammable, burning with a blue flame. It acts as a bleaching agent, resembling peroxide of hydrogen.

With carbon sulphur forms a remarkable compound known as disulphide of carbon (CS_2). It is manufactured on the large scale by heating charcoal in a retort in the vapour of sulphur. It is a colourless, strongly-refracting liquid of disagreeable odour. It is very inflammable, and forms an explosive mixture with air. It is insoluble in water, but soluble in alcohol and ether. The specific gravity is 1·293. It boils at 46·6° C. (115° Fahr.), but it evaporates rapidly in the air, producing much cold. It is a valuable solvent for fats and oils, and dissolves sulphur, phosphorus, and iodine. The solution of phosphorus, with a little wax added, becomes spontaneously inflammable on evaporation, and has been employed in military shells for setting places on fire. It is used also for extracting oils from seeds, grease from wool, and oil from waste. In the laboratory for dissolving iodine in testing, and for solution of some alkaloids.

There are two important oxides of sulphur, sulphurous anhydride (SO_2) and sulphuric anhydride (SO_3). Each take up one atom of water, and in this form may be considered as oxides of sulphydric acid, sulphurous acid (H_2SO_3, or H_2OSO_2), and sulphuric acid (H_2SO_4, or H_2OSO_3). Hyposulphurous or thiosulphuric acid ($H_2S_2O_3$) is another well-known sulphur oxide, and there are four oxides of less importance called polythionic acids—dithionic acid ($H_2S_2O_6$), trithionic acid ($H_2S_3O_6$), tetrathionic acid ($H_2S_4O_6$), and pentathionic acid ($H_2S_5O_6$). Sulphurous anhydride is a gas given off in roasting iron pyrites and other metallic sulphides, or in burning sulphur in the air. In the laboratory it is prepared by heating oil of vitriol with copper turnings. It is a colourless incombustible gas about twice the weight of air. It is very soluble in water, and has a strong sulphurous odour. It is an effective bleaching agent and much employed for bleaching silk and woollen fabrics, and in other cases where chlorine is prejudicial. The gas condenses easily into a colourless liquid on refrigeration. The liquid oxide boils at −10° C. (14° Fahr.), and has a specific gravity of 1·45. At −79° C. (−110° Fahr.) it congeals into a white crystalline solid. This solid form can also be obtained by the intense cold produced by its own evaporation. So rapid is this evaporation, and so great the reduction of temperature, that it is employed in a well-known and striking lecture experiment to produce ice from water in a red-hot platinum crucible.

The solution of the gas in water forms sulphurous acid. The specific gravity is 1·04, and it contains 45 volumes of the gas. It is a strong acid, and acts as a powerful reducing and bleaching agent. It may be detected by its reducing action on iodic acid and starch, from which it sets free the iodine and forms the intense blue colour of iodide of starch, which is again decolourized by excess of the acid in the presence of water, hydriodic acid being formed. Sulphurous acid is dibasic, forming neutral and acid salts, mostly crystalline, and having the respective formulæ M_2SO_3 and $MHSO_3$. These resemble the neutral and acid carbonates, and in many instances are isomorphous. The sulphites and acid sulphites of calcium are employed in bleaching and as antiseptics in the preservation of meat and fish. Many of the sulphites combine together to form double salts. There are several sulphurous ethers: diethylic sulphite, $(C_2H_5)_2SO_3$, is a colourless liquid having an odour of urine. The specific gravity is 1·085, the boiling point 160° C. (320° Fahr.) It is soluble in alcohol and ether, but insoluble in water. The ethyl may be replaced by methyl, forming methyl sulphurous acid (CH_4SO_3), or amyl, forming amyl sulphurous acid $(C_5H_{12}SO)_3$, which, with their derivatives, form a large range of compounds coming under the general term sulphurous ethers.

Sulphuric anhydride may be obtained from strong sulphuric acid by distilling it with phosphoric anhydride. It crystallizes in fine feathery or silky needles. It melts at 18° C. (64° Fahr.), and boils at 35° C. (95° Fahr.) The specific gravity is 1·9456. It has a powerful affinity for

water, and hisses like red-hot iron when dropped into it. The solution forms sulphuric acid. It does not alter litmus in the anhydrous state. It is soluble in disulphide of carbon.

Sulphuric acid is known generally to commerce under the name of *oil of vitriol*, and is manufactured in enormous quantities in this country in the alkali works for the manufacture of sodium sulphate, and in manure works for making soluble phosphates, dissolved bones, &c.; and it is also extensively used in many other manufactures, and is probably the most important of all the chemical products. It is made by burning sulphur, which was at one time the principal source; it is now mostly made by roasting iron and copper pyrites. These are burned in suitable kilns, which allow sufficient access of air to produce sulphurous acid: the gas passes over nitre pots, in which nitric acid is generated from sulphuric acid and nitrate of soda; the two gases pass together into large leaden chambers, and there come into contact with a number of jets of steam. The sulphurous acid takes up oxygen, and becomes sulphuric acid at the expense of the nitric acid, which is reduced to nitric oxide (NO). This again takes up oxygen from the air of the chamber, forming nitric peroxide (NO_2), which, in the presence of water, again reacts on a fresh portion of sulphurous acid, again forming sulphuric acid and nitric oxide according to the following equation:—

$$NO_2 + SO_2 + H_2O = H_2SO_4 + NO.$$

This reaction goes on indefinitely, and theoretically there should be no loss of nitric acid, but practically there is a large loss in the manufacture, and to modify this loss the Gay-Lussac tower has been introduced, and is now used in all well-appointed vitriol factories. It is a leaden tower 50 feet in height, packed with coke and moistened with a continuous stream of strong sulphuric acid trickling down from the top; the exit gases from the last chamber (the chambers are generally worked in sets of three or more) are passed up this tower, and the nitric oxide gas is absorbed by the vitriol. The sulphuric acid drawn from the chamber, and known as "chamber acid," is a brown liquid, having the specific gravity of about 1·56, and it requires evaporation to bring it to the specific gravity of 1·725, which is usually the strength of commercial "brown acid," as employed in the alkali works. It was customary to evaporate this in open iron pans lined with lead, but the evaporation is now usually effected by the hot gases from the pyrites burners. These gases before entering the chambers are passed up Glover towers, and come in contact with the weak acid descending them from a tank at the top: the acid is evaporated by the heat, and the gases enter the chambers much cooled. These towers are made of lead, are about 40 feet in height, and are packed with refractory bricks and large flints. To make the white acid or ordinary oil of vitriol, which has a specific gravity of 1·842, the "brown acid" must be still further evaporated. This is effected either in large glass flasks, or in platinum stills; the water is thus distilled off and the heated acid destroys the organic matter forming the brown colour, and becomes colourless. The lead employed in the construction of the chambers and towers for vitriol-making must be a pure sheet known as chemical lead, and as no solder is used the sheets are burned together by an oxyhydrogen blowpipe.

Sulphuric acid or oil of vitriol (H_2SO_4) is a heavy oily liquid of specific gravity 1·842. It boils at 327° C. (620° Fahr.) and congeals at −35° C. (31° Fahr.) It is extremely hygrometric, and is much employed in the laboratory for desiccation. It takes up water from all vegetable compounds; sugar, for instance, is completely charred by it. By the abstraction of water it converts alcohol into olefiant gas, and formic acid into carbonic oxide. When mixed with water it develops much heat, raising it from the freezing to the boiling point. The mixture contracts on cooling. There are two hydrates, the monohydrate ($H_2SO_4H_2O$) and the dihydrate ($H_2SO_4 2H_2O$). The former crystallizes in six-sided prisms.

Fuming or Nordhausen sulphuric acid, known as *fuming oil of vitriol* ($H_2S_2O_7$), is a definite mixture of sulphuric anhydride and sulphuric acid; it is made at Nordhausen by the dry distillation in earthen retorts of ferrous sulphate or green vitriol. It is a heavy oily liquid, having a specific gravity of 1·9; it congeals at the freezing point of water to colourless crystals. When heated, sulphuric anhydride distils over and sulphuric acid is left behind. It is used in dyeing for dissolving indigo and some of the coal-tar colours. Ordinary sulphuric acid, or oil of vitriol, is the basis of the most important chemical manufactures. It is employed very largely for the manufacture of sulphates of soda and potash, of hydrochloric acid and chlorine from salt, of nitric acid from nitre, and of superphosphates from bones, coprolites, and apatite. The very important salts of this acid, or sulphates, are noticed under their respective bases or metals. Several are found native.

There are a number of sulphuric ethers; the most important is ethyl sulphuric acid or sulphovinic acid, $(C_2H_5)HSO_4$, because it is the product first formed in the manufacture of ordinary ether, and which is decomposed on heating into sulphuric acid and ether. It is an acid oily liquid, of specific gravity 1·315. It forms a number of crystalline salts, called ethyl sulphates or sulphovinates, and having the general formula $(C_2H_5)MSO_4$. Sulphuric ether or diethylic sulphate, $(C_2H_5)_2SO_4$, is a yellow oily liquid, of specific gravity 1·120, and having an odour of peppermint.

Hyposulphurous or thiosulphuric acid ($H_2S_2O_3$) is not known in the free state; but it forms a number of crystalline stable salts, known as hyposulphites or thiosulphates, of which two are employed in commerce, the hyposulphites of calcium and sodium. Calcium hyposulphite ($CaS_2O_36H_2O$) crystallizes in large colourless prisms, very soluble in water. It is used as an antichlore, especially in bleaching paper pulp. Sodium hyposulphite ($Na_2S_2O_35H_2O$) crystallizes in large monoclinic crystals, very soluble in water. It is extensively used for fixing photographic pictures, and as an antichlore. Dithionic or hyposulphuric acid ($H_2S_2O_6$) is an acid liquid, of specific gravity 1·347, easily decomposed, but forming permanent crystalline and soluble salts, called dithionates or hyposulphates, and having the general formula $M_2S_2O_6$.

Trithionic acid ($H_2S_3O_6$) is an acid, bitter liquid, which cannot be concentrated without decomposition. It forms salts which are unstable and soluble in water. The general formula of these salts, called trithionates, is $M_2S_3O_6$.

Tetrathionic acid ($H_2S_4O_6$) is an unstable liquid, forming soluble salts, called tetrathionates, very unstable, and having the formula $M_2S_4O_6$.

Pentathionic acid ($H_2S_5O_6$) can be concentrated to a specific gravity of 1·37; the pentathionates are unstable salts, and all soluble; the formula is $M_2S_5O_6$.

Sulphur is detected in its compounds usually by the evolution of sulphurous anhydride, when exposed to a red heat with access of air. It is weighed in the form of a sulphate, to which it is oxidized by nitric acid. Sulphuric acid can always be detected by the very insoluble compound formed with barium, in which form it is usually estimated.

Many attempts have been made to extract the sulphur on a large and profitable scale from alkali waste, and many patents have been taken out for this purpose. The whole of the sulphur used in alkali works is lost in this waste, which, moreover, is produced in enormous quantities; and the sulphides, washed out by the rain, pollute the adjacent water-courses. Two important improvements have been affected in this direction. In the first of these the waste is oxidized in the vats after lixiviation, by blow-

ing air through it; the object is to produce such a mixture of sulphuric oxides that the whole of the soluble sulphur may be precipitated by an acid. This process, however, only recovers a part of the sulphur, and leaves the waste almost as bulky as before, but it has been much used. A more recent process deals with the whole of the waste, and recovers all the sulphur. The waste is mixed with solution of magnesium chloride, which dissolves it, and converts the sulphur into sulphydric acid gas, which is collected in a gasometer and burned to form sulphurous anhydride for making vitriol. Calcium chloride and magnesia remain, the lime is precipitated as carbonate by carbonic acid gas generated from the lime kilns, and the precipitated carbonate is used in the ball furnace, the chloride of magnesium being thus regenerated for further use. One of the chief difficulties in this process is the deadly and dangerous character of the sulphuretted hydrogen gas evolved, which forms an explosive mixture with air. It has given rise to many accidents in chemical works, and is very difficult to deal with. This ingenious process would no doubt have been largely adopted by manufacturers had not the great pyrites producing companies reduced the price of the unit of sulphur to compete with it.

Sulphur Trade.—Although sulphur exists in Iceland, Teneriffe, St. Vincent's, and some other places, the expense of obtaining it is so great that Sicily is almost the only source of supply. From that country England and France take 90 per cent. of the whole quantity exported. The Sicilian sulphur mines are the property of individuals, and from fifteen to twenty English firms settled in Sicily are engaged in the trade. In 1836 M. Taix, a Frenchman, laid before the Sicilian government a project for establishing a company which was to have the exclusive right during ten years of purchasing Sicilian sulphur at fixed prices, on condition of spending £10,000 a year in constructing roads, and exporting one-third of the quantity produced in Sicilian vessels. The British merchants becoming alarmed, the Sicilian government, in reply to the British government, stated that no such project would be adopted. It would have been in direct contravention to certain commercial treaties between the two governments. The Sicilian government did, however, enter into a contract with M. Taix, and on the 4th of July, 1838, notice was given at Palermo that the monopoly would come into operation on the 1st of August ensuing. The negotiations respecting this monopoly were conducted with great secrecy, and it came into operation so suddenly that twenty-four vessels lost their cargoes. The British lessees of mines, and all others, were compelled to produce only a fixed quantity of sulphur; prices rose more than twofold, contracts could not be completed, the exports became inadequate to the English demand, and other quarters were looked to for a supply. At length the British government took very decided steps put an end to a monopoly established in the face of commercial treaties. In 1840 it was accordingly abolished, and £21,307 paid as compensation to those whose interests had been injured by it. The chief mines are at Villarosa, Santa Catalda, and Terra di Falco. The sulphur lies embedded in tufa, gypsum, or limestone, mostly at the sides of mountains.

The quantity of sulphur annually imported into the United Kingdom is about 900,000 cwts., of the value of nearly £300,000, or a little less than 7*s.* a cwt. Upwards of nine-tenths of the whole quantity is received from Sicily.

Medicinal Properties of Sulphur.—Sublimed sulphur, or "flowers of sulphur," is the form most used for medical purposes. Sublimed sulphur is a slightly gritty powder, of a fine greenish-yellow colour, without taste and without odour till heated. Precipitated sulphur, or "milk of sulphur" resembles sublimed sulphur in its general properties, but is much paler in colour, and is in a finer state of division. Sulphur is taken internally as a laxative, and as the motions which follow its administration are of a soft nature, it is a very useful medicine when there is any affection of the lower bowel, such as piles, stricture, or fissure. It is gentle and sure in its action, but the evacuations it causes are extremely fetid, and it sometimes causes a very offensive smell in connection with the ordinary insensible perspiration of the body. As a purgative, the dose is from 20 to 60 grains or more, made into an electuary with treacle or honey. Another form is that of "confection of sulphur," made by mixing 4 oz. of flowers of sulphur with 1 oz. of cream of tartar in powder, and 4 oz. of syrup of orange-peel, the dose being one or two table-spoonfuls taken once or twice a day, according to the effect desired. Used externally, sulphur is a very useful remedy in many diseases of the skin. It is a specific for the cure of the itch [see ITCH-MITE], and is a valuable adjunct in the treatment of lepra, psoriasis, and other cutaneous affections. It is used for these purposes in the form of an ointment made by rubbing up one part of flowers of sulphur in four parts of benzoated lard. Sulphur lotion, a useful application in some cases of slight irritation of the skin, may be made by adding a tea-spoonful of flowers of sulphur, and two table-spoonfuls of glycerin to half a pint of rose water.

Medicinal Properties of Sulphuric Acid.—In medicine, dilute sulphuric acid, made by gradually and cautiously adding one part of sulphuric acid to twelve parts of water, is used internally as an astringent, and is especially useful in cases of weakening, night sweats, and in profuse serious diarrhœas. The diarrhœa mixture of the London hospitals, which may be made by combining 2 drachms of dilute sulphuric acid, 1 drachm of tincture of opium, and 1½ drachms of spirit of chloroform with 8 oz. of water, is a very useful preparation, and there is no doubt that its free use in England does much towards reducing the mortality from summer diarrhœa. It is not suited for children, however, on account of the opium it contains. In cases of painter's colic and other forms of lead poisoning dilute sulphuric acid is an efficient antidote, as it has the effect of converting the lead that has been absorbed into an inert insoluble sulphate. Sulphuric acid, lemonade, and treacle-beer, acidulated with sulphuric acid, are also used in lead-works as prophylactics against these diseases. The aromatic sulphuric acid of the Pharmacopœia is prepared by mixing three parts of sulphuric acid with forty of rectified spirit, two of powdered cinnamon, and one and a half of powdered ginger, digesting for a week and filtering. Its use is much the same as that of the dilute acid, the dose being from 5 to 30 minims. In cases of accidental poisoning from sulphuric acid the best antidotes are tepid water in large quantities to produce vomiting, powdered chalk, whitewash soap and water, oils and milk.

Sulphurous acid is much used as an antiseptic, especially in the gaseous state, for disinfecting rooms. It is also used externally as a lotion for parasitic affections, and as a spray for the throat. Sulphite of sodium and hyposulphite of sodium are both used in medicine. Sulphide of calcium is recommended as a sovereign remedy for boils and carbuncles; one-tenth of a grain is taken every hour.

SUL'TAN or **SULTAUN,** an Arabic word, evidently nearly akin to the Hebrew *shalal*, to rule. It is the title of many various Mohammedan princes, though it is most commonly applied by Europeans to the head of the Turkish Empire, whose proper distinction is *Padishah.*

SU'LU ISLANDS. See SOOLOO.

SUM AND DIFFERENCE. There is no need to define the arithmetical meaning of these terms: a few words only are necessary to put forward their proper position in algebra. When quantities receive their proper algebraical signs, and those signs their interpretations, they are said to be added to a quantity when they are allowed

to produce their effect, and subtracted when they are allowed to produce a contrary effect. And when quantities are put together so that each produces its simple effect, they are said to be added together; while any parcel which is either withdrawn, or compensated by others of equal and opposite effects, is said to be subtracted. We are not here discussing principles, but settling terms; and it is enough if the notions appended to them are proper foundations for clear and good deduction; and an additional advantage if common ideas and received phraseology are also suited, provided that nothing be assumed from such ideas and phraseology to the prejudice of the dependence of the deduction upon the prescribed definitions.

To form a just idea of the property of any person, we take the sum which he owes away from his assets; that is, we take away, not his debts, but sums out of his assets equal to his debts. To say this is taking away his debts would not be correct; for taking away his debts would be merely destroying his liabilities, without making his assets answerable: a person who pays another's debts thereby takes them away. A court of justice which decides a claim against the assets of any one annexes or puts on a liability; and this is in algebra *adding:* if the decision should be reversed on appeal, this liability to pay is removed, and this is in algebra subtracting. By some persons those ideas of algebraical operation to which common idioms adapt themselves are easily received, as if the understanding of these common idioms were the same as that of the algebraical proposition; while other operations which have no such common phrases to illustrate them are difficulties.

SU'MACH or **SUMAC.** See RHUS.

SUMA'TRA (Arabic *Srimata*, the happy) is a large island in the Indian Ocean, and the most western of the Sunda group. The equator traverses it nearly in the centre. The general direction of the island is nearly north-west and south-east, and its length rather exceeds 1000 miles. The width south of 1° N. lat. is on an average 210 miles, but further north it is not more than 140 miles. Its area is about 168,000 square miles.

The south-west side of Sumatra is bounded by the Indian Ocean, the north part stretches into the Bay of Bengal, and the north-east is divided from the Malay Peninsula by the Straits of Malacca. Between the south extremity of these straits and the island of Banca, Sumatra is washed by the Chinese Sea. The coast south of the Strait of Banca abuts on the Java Sea, and the southern extremity of the island is separated from Java by the Straits of Sunda. The coast in general presents a regular outline, broken by few bays or headlands except in the north and north-east, though there are several good harbours. The level of the whole island is said to be gradually rising.

Various mountain chains, nearly all covered with forests, run through the island longitudinally, sometimes in treble or fourfold ridges, and generally varying in altitude from 1500 to 6000 feet. Some elevated and conspicuous peaks, indeed, most of which are volcanoes, rise at wide intervals to 14,000 or 15,000 feet. These mountain ranges are always much nearer the west than the east coast. The longitudinal valleys on the west side are often 10 miles wide, and in one instance at least 100 miles long, and have a moderate fall, admitting of irrigation and the cultivation of rice, consequently they are the chief seats of the indigenous population and of the characteristic civilization of Sumatra. The east coast of the island is of a totally different character to that of the west, as it spreads out into interminable plains nearly as level as the sea. The chief of the sluggish streams in this part are the Rawas, or river of Palembang, which falls into the Strait of Banca, and is navigable for a distance of 200 miles; the Jambi, the sources of which are near Talang and Indrapur; and the Indragiri, which springs from the feet of Merapi and Singallang. The rivers on the west coast are very numerous, but are, with few exceptions, little better than mountain torrents. Of the lakes inclosed in the highland valleys, the best known are Sinkara and Dano, the former lying south-east, the latter north-west of Merapi and Singallang. Sinkara, about 17 miles long and 6 miles wide, lies at an absolute elevation of 1035 feet above the sea. Dano, at a height of 1500 feet, is much smaller. The climate is not oppressively hot; in the plains at mid-day the thermometer usually marks 82° to 85°, and sometimes 88°, but at sunrise not more than 70° Fahr.

The great equability of temperature on all the coasts and lower parts is mainly owing to the circumstance of the island being comparatively narrow, for the wind which comes directly from the sea is not so warm as that which has passed over large tracts of land in tropical countries. On the west coast, south of the equator, earthquakes are frequently felt; but in general they are very slight compared with those of South America and other countries. The mountain ranges on the south and west arrest much vapour, and consequently rain falls very often in this part of the island. Dense fogs, thunderstorms, and water-spouts are also very frequent off the coast. There are extensive marshes in the eastern part of the island, near which intermittent and typhoidal fevers, dysentery, and other diseases prevail.

Rice is grown in the lowest plains and in the elevated valleys of the mountain ranges. No other grains are much cultivated, except maize and millet. The most common esculent vegetables are different kinds of yams; sweet potatoes; common potatoes, in the more elevated districts; bredy, a kind of spinach; lobuck, or the Spanish radish; the large purple brinjall, or egg-plant; and many different sorts of beans, with white and green pease, and onions. The latter are articles of export from the north-eastern coast to Penang and Singapore. Chili or capsicum, turmeric, ginger, coriander, and cumin-seed are raised, especially on the western coast. Hemp is extensively cultivated, but only for smoking with tobacco, which latter is an article of export from the harbours on the north-eastern coast. Melons are raised on the plains, and sometimes attain an extraordinary size. Sesamum is cultivated for its oil; and the Palma-Christi, from which castor-oil is obtained, grows wild. The sugar-cane is only cultivated for chewing; no sugar is manufactured, but it is imported from Java. The plantations of betel-vines are extensive. Indigo and cotton are raised for domestic use only. The fruits are abundant, and superior to those of Java in flavour. They include the cocoa-nut plantains, banana, the bread-fruit tree, jack-tree, mangosteens, durians, mango, different kinds of orange and lemon trees, especially the shaddock; the pine-apple, the jambo, the guava, the papaya, the custard-apple, the pomegranate, and the tamarind. European fruit trees do not thrive, but the vine is successfully cultivated. The pepper plant is very abundant, and coffee, cacao, sago, cloves, and nutmegs are grown. The Dutch government compel the natives to deliver them a certain quantity of pepper and coffee annually. The forests supply an inexhaustible variety of timber, including the *Urceola elastica*, from which caoutchouc or India-rubber is obtained, and the gutta-percha tree (*Isonandra gutta*). There are also several kinds of trees from which camphor, gums, resins, scented-wood, and teak are obtained. The extraordinary parasite named *Rafflesia Arnoldi*, after Sir Stamford Raffles and its discoverer Dr. Arnold, is included in the flora of Sumatra. It has no leaves or stem, and only minute fibres for roots, which are inserted in a species of vine. Yet it clings to the bark of large trees, and produces the largest flower in the world, it being more than a yard in diameter, weighing 15 lbs., and having petals as large as cows' horns.

The most useful of the domestic animals is the buffalo, which attains an extraordinary size. It is generally used for agricultural purposes and as an animal of burden. The horses generally are of a small breed, but well made and hardy. Sheep are few, and of a small size. Goats are numerous, but they are also small. A kind of wild goat found in the forests is much larger. The hog is of the Chinese breed, and in some parts by the number of their pigs is estimated the wealth of the community. Few domestic animals are kept by the inhabitants of the great plain. Elephants, hippopotami, rhinoceroses, tigers, leopards, bears, tiger-cats, tapirs, deer, antelopes, and monkeys (including the orang-utan) are numerous. Crocodiles and other reptiles, insects, fish, and fowl are also abundant. The peacock and pheasants are renowned for their beauty. Gold, tin, copper, iron, lead, silver, sulphur, saltpetre, coal, salt, alum, and naphtha are found. The predominant rock is trachyte. With this occur granite, sienite, porphyry, red sandstone, and limestone in many varieties. Basalt exists along the coast, and at some points colossal basaltic columns form convenient landmarks.

The inhabitants of Sumatra, with the exception of two or three small savage tribes, comprise the Acheenese, the Battahs, the Malays, the Sumatrans, and the Lampongs. The Acheenese, who are stated to be of Moorish descent, occupy the most northern part of the island, and differ considerably from the other tribes, being in general rather taller, stouter, and of a darker complexion. They are more active and industrious than their neighbours, but cunning, proud, treacherous, and bloodthirsty. They live simply, but are slaves to opium. In writing they use the Malay characters. The Battahs occupy the sea-coast on the west side of the island. They are rather below the stature of the Malays, and their complexions are fairer. The MALAYS occupy the whole of the great plain from the river Rakan on the north to that of Masusi on the south, and also the shores north of the Rakan River as far as Timian. The Sumatrans comprehend all the tribes that inhabit the west coast, from 40′ N. lat. to 5° S. lat. They are rather below the middle stature. Their complexion is yellow, and much lighter than that of the Hindus. Upon the whole they are gracefully formed, their limbs being for the most part slight, but well shaped, and particularly small at the wrist and ankles. They have, however, the preposterous custom of flattening their noses and compressing the heads of children newly born whilst the skull is yet cartilaginous. They likewise pull out the ears of infants to make them stand at an angle from the head. The hair is strong and of a shining black. The men make themselves artificially beardless. The Lampongs, who occupy the most southern part of the island, have a strong resemblance to the Chinese, particularly in the roundness of the face and the form of the eyes; otherwise they do not differ in their persons from the Sumatrans. They are the fairest people in the island, and the women are the tallest and handsomest.

The principal seats of the Dutch possessions are at BENCOOLEN, Padang, and Palembang. The population has been estimated at about 2,500,000. The Europeans in the island do not exceed 2000 in number. There is no trace of any system of religious opinions among the native tribes of Sumatra. They have no temples, no priests, and no idea of divine beneficence. Their Begu seems to be an evil spirit, and demons are supposed to haunt the high mountains. On the coasts Buddhism appears to have been introduced at an early age, but it has been since completely superseded by Mohammedanism, which among the Malays, however, is everywhere of a very relaxed character. The Arabian doctrines of Islam, though seductive and ordinarily successful among half-civilized men, found in the interior an insurmountable obstacle in the popular economy, for the Sumatran prides himself on his droves of swine.

The Battahs have practised the art of writing from a date beyond the reach of their traditions. Their characters are peculiar, as well as their mode of writing, for they begin at the bottom of the page, at the left-hand side, and place letter above letter in a vertical column till they reach the top, when they return to the bottom, at the right, to begin a second line. Their ancient books are written in a brilliant ink, on paper made of the bark of trees. At the present day ink has fallen into disuse or been forgotten, and modern Battah writing is scratched with an iron style on slips of flattened bamboo.

The natives of Sumatra, as a rule, display great ability in manufacturing industry, especially in gold, silver, iron, and steel. They also weave cotton and silk in a very superior manner, and build excellent and very beautiful boats, but seem almost entire strangers to painting and drawing. Except in the immediate vicinity of the Dutch seats of government, the agriculture of the island is in general very backward and slovenly; nature has been so bountiful, and the natives require comparatively so little, that there is not much incentive to exertion and improvement. A rude spade and hoe are the only implements. On the highlands of the Battahs, however, are canals of irrigation, 10 feet wide and 4 or 5 miles long, carried along embankments, and surpassing in design and execution anything of the same kind existing in Java. The labours of the field fall chiefly on the women, and in some parts, indeed, it is customary for the men to stay at home nursing the children while the women toil in the rice-fields. Unmarried girls, however, are exempt from field work, except at the time of the rice harvest, when none are spared, young or old, who are capable of assisting. In thus oppressing the weaker sex with an undue share of labour the Battah men are guided solely by the wisdom of their ancestors, or more properly speaking, by traditional barbarity.

History.—Marco Polo notices Sumatra under the name of Java Minor. Its present name occurs first in the travels of Nicolo di Conti, who visited it before 1449. The Portuguese made unsuccessful attacks upon the coast in 1509, 1575, and 1582. The Dutch first appeared on the north coast towards the close of the sixteenth century, and the English in 1602. The pepper trade was the great object of these two nations; the Dutch formed a settlement for this purpose at Padang, in 1649, or shortly before, and the English at Bencoolen, in 1685. The latter afterwards pushed their commercial establishments southwards to the vicinity of Flat Point, and erected others at Natal and around the Bay of Tapanooly, whilst the Dutch increased theirs in the intermediate space. But the Dutch had also got a firm footing in the southern districts of the island. Thus affairs remained until the year 1811, when the Dutch possessions, together with the island of Java, fell into the hands of the English. At the conclusion of the war the Dutch regained all their settlements, and by subsequent negotiations all the British districts were given up to them in exchange for Malacca. They had frequent collisions with the natives, but each disturbance only extended their territory and power further into the interior and towards the north-west of the island. In 1824 a treaty was concluded between the English and Dutch, by which both were to refrain from annexing further territory in Sumatra, and the only remaining independent kingdom, Acheen, regarded itself as thus in some sort under English protection. In 1872 the English government, desiring to consolidate its possessions on the west coast of Africa, accepted the transfer of Elmina from the Dutch, and in return agreed to withdraw from the treaty of 1824. The consequence was that both nations speedily became involved in war, the British with Ashantee and the Dutch with Acheen. The latter made a vigorous and, for some time, successful stand against Dutch aggression, but was ultimately obliged to succumb to the stronger and more

civilized power of Holland. The whole island is now a colonial possession of the rulers of Java, although not held in the same subjection, the authority of native sovereigns being still acknowledged to some extent.

SUMBA'WA or **SOEMBAWA** is an island of the Malay Archipelago, bounded on the N. by the Java Sea, S. by the Indian Ocean, W. by the Strait of Allass, separating it from the Island of Lombok, and on the E. by the Strait of Sappi, separating it from the islands of Comodo and Flores. The island is about 160 miles long from east to west, by 31 miles extreme breadth, and of irregular form, being deeply indented by arms of the sea. Along the coasts lie a number of small islands. It is divided into six native states, reigned over by rajahs: Tomboro or Tombura, and Sumbawa on the north coast, whose inhabitants are the bravest in the island; Bima, on the east, where the Dutch have a resident; Dompo, Sangar, and Papekat: all of them acknowledge subjection to the Dutch. The inhabitants (about 80,000) belong to the Malay race and are industrious. The soil is exceedingly volcanic, and in some places of great fertility, being watered by several streams. Sapan-wood and rice are the chief products, beyond the usual tropical fruits. Deer and swine are plentiful, but cattle, goats, and fowls are not abundant. There are two breeds of horses, that of Tomboro and that of Bima; the latter, the finest in the Malay Archipelago, is extensively bred and exported. Fish are plentiful, and edible birds' nests are procured on the coasts. Gold is obtained in Sumbawa and Dompo, sulphur and saltpetre in Bima, and pearls on the coast of Papekat. Sumbawa is mountainous, and its heights have such a remarkable appearance that once seen they are never forgotten, a fact which renders them an excellent landmark for ships passing to and from China. Near the north coast is the noted volcano of Tomboro, 8940 feet high. Here a dreadful eruption took place in April, 1815, the noise of which was heard in Celebes, the Moluccas, and Sumatra, or over an area with a radius of above 840 miles from the volcano. In the island of Sumbawa itself upwards of 12,000 people perished. In addition to the earthquake the sea also rose and swept away both men and houses, and fifteen years afterwards the vegetation had not recovered from the effects of this dire disaster. Another eruption occurred in November and December, 1836, but was much less destructive in its effects.

SUMBAWA, a town on the north coast of the island, 100 miles west of Bima, has a good harbour, and is the residence of a chief, subject to the Sultan of Bima.

SUMMA'TION TONES, a species of musical ghosts, or spectral sounds, produced by the clash of the aerial sound-waves without the existence of any corresponding sound-source, yet audible by the ear as if they were actual sounds. Another class of such sounds is called *Difference Tones;* and both classes together make up COMBINATIONAL TONES, under which heading the whole subject is investigated.

SUMMER, the hot season of the year, its culmination, so to speak, whence the origin of the name (the Sanskrit *samâ*, meaning year), as if the summer gathered the year to itself, fulfilling the promise of spring by producing the crops and ripening them ready to hand over to the autumn. The French Republican summer began with the summer solstice (22nd June), but the popular verdict reckons May, June, and July as the summer months, and calls the solstice (or what stands duty for it, St. John's day, 24th June) midsummer.

Summer opens with the sports of May Day, and is throughout the jolly season (the epithet is Spenser's), the season of out-door mirth and of holiday. It gives us our warm long days and our fine weather (though August, it must be added, is often one of the finest months of the year), and is most unfairly maligned by the foreign critic who described the English summer as made up of a series of three fine days and a thunderstorm. Spenser's allegorical representation of summer is very beautiful ("Faerie Queene"):—

"Then came the jolly Sommer, being dight
In a thin silken cassock coloured greene
That was unlyned all, to be more light,
And on his head a girlond (garland), well besCene,
He wore, from which, as he had chauffed (heated) been,
The sweat did drop; and in his hand he bore
A bowe and shaftes, as he in forrest greene
Had hunted late the Libbard or the Bore
And now would bathe his limbes, with labor heated sore."

It is interesting to note that in the northern hemisphere the summer is three days longer than the winter, and in the southern hemisphere of course the reverse takes place. We count 184 days from 25th March to 29th September, and only 181 from September to March. Whence it might hastily be concluded that our summer, blessed as it is with three more days of sunshine and having three less days of frost to battle against, should be considerably warmer than the summer of Australia. But rather the contrary is the case, and the cause is in the ellipticity of the earth's orbit, which throws us furthest from the sun during our summer, while the summer of the antipodes occurs when the earth is nearest to the sun. The heat received in perihelion (Australian summer, *i.e.* Christmas) is to that in aphelion (English summer) as 1·034 to ·967, a difference through nearness of the sun more than enough to compensate for the three extra northern days.

The frequency of hail in summer and the rapidity of electrical and other meteorological changes are well-known features of the season. The familiar and beautiful "summer lightning" which flashes the sky with gold is due to reflection from the atmosphere of discharges of very distant lightning.

SUMMER DUCK (*Aix sponsa*) is a species of DUCK (Anatinæ). This beautiful little duck is confined to America, and ranges over the whole extent of the United States, migrating southwards in winter. It frequents fresh water only, and does not appear to be strictly migratory in its habits. It builds its nest in the hollows of trees, or in the hole made in some large branch by one of the larger woodpeckers. It breeds freely in captivity; but in its wild state it is shy and recluse, preferring the secluded retreats of the ponds or creeks in the woods. This duck has the head adorned with a crest which, like the head, is of a metallic green colour. The upper parts of the body are blackish, with bronze, green, and violet reflections; the sides are yellowish, banded with black and posteriorly with white; the under surface is white. The length is about 19 inches.

Another species of this genus is the Mandarin Duck or Chinese Teal (*Aix galericulata*), which divides the palm of beauty with the summer duck. It is a native of China, but breeds freely in our aviaries. Like the summer duck it is arboreal in its habits, and roosts on trees.

SUMMER SOL'STICE (22nd June). See SOLSTICES. As our Christmas festivities are derived from the ancient pagan festivals of the winter solstice, so were formerly the great festivals of midsummer derived from the similar celebration of the summer solstice. These have now almost all died out. The main ceremony was the lighting of a bonfire (originally a *bone-fire*, and probably really a fire of bones offered as a sort of sacrifice), and persons dancing round and leaping through this bonfire in honour of the sun were rendered lucky for the year. It is but a few years since midsummer bonfires died out in remote parts of England, and especially of Scotland. At the conclusion of the dances each one snatched a burning brand, which was carefully preserved during the year. The rest of the fire was scattered, and with it were scattered the evils, if any, oppressing the community; so ran the

superstition. It seems clear that in many tribes of our remote ancestors the year was held to begin at midsummer, though that etymology which would derive May from major and June from junior, *i.e.* the end of the old year and the beginning of the new, is of course inaccurate. A ceremony recorded by many ancient observers is the rolling of a wheel down a hill, probably to symbolize the course of the revolution of the sun, henceforward constantly to descend in the heavens. "The wheel is come full circle," as Shakespeare says; but in the popular view this wheel as it rolled bore the year's ill-luck away from the people, and being twined with burning straw, consumed it utterly.

Up to less than 100 years ago fern-seed was collected for magical purposes at the summer solstice. It could not be gathered, in the proper sense of the term, for the fern might not be touched, but it was allowed to fall of its own accord into the plate. It was held to confer invisibility, among other wondrous properties, a circumstance frequently alluded to by the Elizabethan dramatists, as Ben Jonson ("New Inn")—

> "I had
> No medicine, sir, to go invisible,
> No fern-seed in my pocket."

Or Shakespeare ("Henry IV.," Part I., ii. 1), "We steal as in a castle, cock-sure; we have the receipt of fern-seed, we walk invisible."

The truth is that fern-seed was meant to be a hoax, a sort of "pigeon's milk" or other impossibility, for ferns, very absurdly, were held to be seedless by our unobservant ancestors. So Butler, as late as Charles II.'s day ("Hudibras"), speaks of things

> "That spring like fern, that insect weed,
> Equivocally, without seed."

SUMPHO'NIA, a musical instrument mentioned in the Book of Daniel (iii. 5, 10, 15), and there translated dulcimer, is now held by the best authorities to be the bagpipe, a view strengthened by the Italian name for that instrument, *Zampogna*, which is evidently derived from the same root.

SUMP'TUARY LAWS. These were laws against luxury and extravagant expenses in dress, diet, and the like. There were formerly existing in England a multitude of penal laws as to dress, chiefly made in the reigns of Edward III., Edward IV., and Henry VIII., against spiked shoes, short doublets, and long coats. Until a short time ago there still remained one statute unrepealed, 10 Edward III. c. 3, which ordained that no man shall be served at dinner or supper with more than two courses, except upon some great holidays there specified, in which he might be served with three. Sumptuary laws still exist in the great universities, though few undergraduates observe them. At Oxford it is punishable to wear garments of gayer colour than a "subfusc" hue, for example.

The principle was taken from the well-known sumptuary legislation of the Romans. The great fear of the noblest of the Romans was always that the republic was degenerating from its ancient simplicity and austerity; and it is from this sentiment that later on many persecutors of the Christians are found among the best and purest of the emperors. Among the first of the republican sumptuary laws was the Lex Oppia (B.C. 215), forbidding a lady to wear more than half an ounce of gold, or put on a party-coloured dress, or ride in a carriage save to sacrifice. Others of the long list are the following:—The Lex Orchia (B.C. 181) limited the number of guests at dinners. The Lex Fannia (B.C. 61) decreed that not more than 100 ases should be spent on the dinners at the great festivals, not more than 30 ases on holidays, nor 10 ases on ordinary days. The expenses of dress, of entertainments, and of sacrificial rites were dealt with, and even the extravagance of funerals (in the Lex Cornelia of the Dictator Cornelius Sulla, B.C. 81) did not pass without rigorous check. Finally, the Lex Julia of the Dictator Julius Cæsar summed up what was desirable to re-enact in the older sumptuary laws; and in carrying it out the great dictator sent men into the markets to confiscate unauthorized food, and even into the banqueting halls to take away forbidden dishes from the very tables.

Many of the emperors also passed sumptuary laws, but with surprisingly little effect.

SUN. The sun, though really a vast globe, appears to the unaided eye in the form of a circular disc, of which the diameter subtends at the eye an average angle of about 32′. The mean distance from the earth to the sun, as determined by the most recent investigations, ranges between 92,200,000 and 92,700,000 miles. A mean between these two of 92,500,000 miles is almost certainly within 200,000 miles of the truth. It is easy to calculate from these figures that the diameter of the sun is about 850,000 miles, *i.e.* about 109 times the diameter of the earth. The volume of the sun thus exceeds the volume of the earth more than a million-fold, while the weight of the sun is about 320,000 times as great as the weight of the earth.

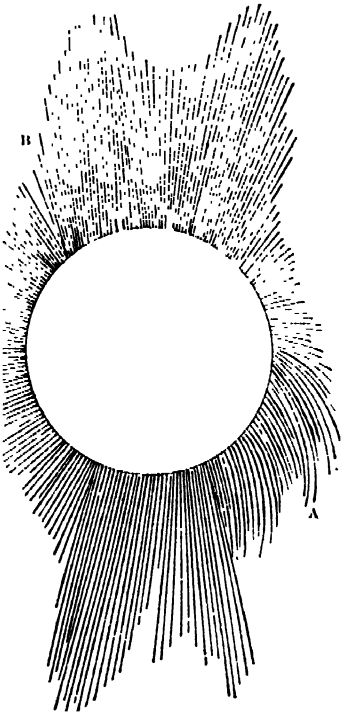
When a telescope is applied to the sun we generally find that the splendid brilliance of its surface is diversified by the presence of one or more groups of dark-looking spots, as shown in fig. 1, Plate I. If the definition of the telescope and the state of the atmosphere be really satisfactory, then it is seen that the whole bright surface presents a granulated appearance, as seen in fig. 5. Photographs taken exhibit this structure of the sun's surface in a very remarkable way. It is then seen that between the luminous granules are multitudes of small dark dots, which seem to be openings between the myriads of small intensely bright bodies to which the brilliancy of the sun is due.

The disc of the sun when viewed through a smoked glass is seen to be brightest at the centre, shading off on all sides towards the edge of the disc. This variation in the radiation extends to the luminous, the heat, and the chemical rays. Measurements have shown that each square minute near the edge of the sun gives about half as much heat as an equal area at the centre, about one-third as much light, and less than one-seventh of the chemical rays. This variation arises from the great absorbing atmosphere surrounding the sun, the rays from the sun's edge having a much greater thickness of atmosphere to traverse than the rays from the centre.

Experiments have been made with the view of determining the amount of heat actually received by the earth from the radiation of the sun. It has been calculated that heat is such that 100 feet thick of ice over the surface of the earth would be melted in a year. Experiments made with a burning glass show that the temperature of the sun must be enormously high. It can be proved that the temperature of the sun cannot be less than the temperature attained at the focus of any burning glass. Yet agate, fire-clay, and other most refractory substances have been fused at the focus of a very powerful burning glass. There can be no doubt that if the sun were as near to us as the moon the solid earth would melt like wax.

The discovery of the sun-spots was an immediate consequence of the invention of the telescope by Galileo. The first observations were made by Fabritius in 1611, and his discovery was followed up by Scheiner and Galileo. It was soon ascertained that the spots had a regular motion across the disc of the sun from east to west, and it was inferred from the disappearance of the spots on one side, and their reappearance on the other, that the sun rotated on its axis in a period of about twenty-five days. The varying position of the earth with regard to the sun, combined with the inclination of the sun's axis to the plane of the ecliptic, amounting to 82° 45′ according to Carrington, and 83° 5′ according to Spörer, causes the earth in its annual revolu-

tion to be sometimes above the plane of the sun's equator, when the spots appear to describe ellipses, the concavity of which is turned towards the northern pole of the sun, and sometimes below it, when the sun's southern pole is viewed, the concavity being then turned the opposite way. In two points of the earth's orbit diametrically opposed to each other, the earth is in the plane of the sun's equator, and these points are termed *nodes;* one being the ascending, the other the descending node. At these periods, about 4th June and 6th December, the courses described by the spots appear to be straight lines, as in fig. 4, Plate I. Consequently from June to December the courses of the spots form concave lines towards the north pole of the sun, and from December to June they appear concave towards the south pole. For the study of the sun-spots the method used by the early observers is often convenient, especially to the possessors of small telescopes. The telescope must be attached to some sup-



port which will admit of the instrument being pointed t the varying positions of the sun. Around the object-glas end of the telescope should be a large screen made of card board or other light material, so as to intercept the direc rays which do not traverse the object glass. If the eye piece be now drawn out about one-eighth of an inch beyon the point appropriate for distinct vision, and if a sti sheet of white paper be held 6 or 12 inches behind the eye piece at a certain distance, a clear image of the sun's dis will be formed on the paper. The exact distance of th sheet of paper at which the image is most sharply define must be determined by trial. Telescopic views of sun spots are given in figs. 2 and 3 of Plate I., while fig. shows the variations in the appearance of a single spot a intervals of two days.

The amount of spots on the sun is extremely variable but it is remarkable to find that the fluctuations in th umber of these appear to be periodic. The average length of 1e sun-spot period is eleven years and one month. During wo or three years the spots are larger and more numerous ıan on the average; they then begin to diminish, and each a minimum five or six years after the maximum. nother six years brings the return of the maximum. urther research will, however, be necessary before the aws of this variation can be understood, and at the present time the causes of these variations is quite unknown. t has, however, been noticed that auroras and other henomena connected with terrestrial magnetism bear some elation to sun-spots, the occurrence of magnetic disturbnces being most frequent when the sun-spots are most umerous, as is clearly shown in the diagram, fig. 7, Plate I.

On the somewhat rare occasions when the sun is obscured y a total ECLIPSE certain very remarkable appendages to he sun are frequently observed, which under ordinary circumstances are invisible in consequence of the diffused unlight from the earth's atmosphere. The appendages witnessed on such occasions are the protuberances and he corona.

The general appearance of these appendages may be seen in Plate II., figs. 1 and 2, and also in the annexed figure, which represents the appearance presented during the total eclipse of 29th July, 1878. The drawing was made at Capitol Hill, at Denver, Colorado, by he experienced astronomer Mr. Lewis Swift. The telescope employed was an achromatic one of 4½ inches aperture. Mr. Swift writes: "By far the most wonderful and unaccountable phenomena attending a total eclipse are the uminous pencils of light extending from the sun like the adii of a circle, to the distance of several millions of niles, though seldom or never reaching to equal lengths n all directions. The drawing is a very correct representation of it as it appeared to my eye and mind. It will not escape notice that the pencils of light extend to a far greater distance in the direction of the moon's path, though this is not the case in all eclipses. That there should be any variation from an exact circular contour is only another of the many mysteries which environ the subject of solar physics.

"The salient features of the corona must not be omitted, viz. the curvature of the rays at A and the tangential direction of those at B. For about 60 degrees of the moon's circumference the rays were decidedly curved, as represented in the diagram, and for about 30 degrees they were perfectly straight; but if their paths were traced backwards they would not meet at the sun's centre, as would all the others."

The ring of light surrounding the dark disc of the sun is the *chromosphere*, and projecting from it are certain prominences. They are of a pink or ruddy colour, as shown in figs. 1, 2, and 5, Plate II., and undergo rapid changes in size and form. The prominences appear to be only salient portions of the luminous chromosphere. The spectroscope shows that they are principally masses of glowing hydrogen, and their general appearance, when examined by a sufficiently powerful telescope, is represented in figs. 3 and 4.

It was discovered independently by Janssen and Lockyer that the spectrum of a prominence could be viewed by the spectroscope without an eclipse of the sun. Under ordinary circumstances the diffused light from the sun obliterates the faint light of the prominences, but if the diffused light could be got rid of by any means they would be seen. A spectroscope of high dispersing power attenuates the diffused light to so great an extent that the bright lines of the prominences become visible. It is thus possible to map out each clear day the shapes of the various prominences with which the sun is surrounded.

A further wondrous advance in the means at our disposal for observing the sun has been achieved by Mr.

Huggins, who has succeeded in photographing the corona without an eclipse. The success of this method is due to the interposition of a coloured medium which, while it greatly enfeebles the ordinary light of the sun, is so constituted as to afford the particular rays from the corona almost an uninterrupted passage.

The sun is the source of light not only to the earth and to the moon, but to Mercury, Venus, Mars, Jupiter, Saturn, and all the other planets and their satellites. A planet so often resembles a fixed star that it is difficult to realize how profound is the difference. The sun's light, however, which illuminates the planet so as to make it a brilliant object, is not the cause of the brilliancy of the stars. Each star shines by its own light, and is in fact a sun of itself.

The supreme importance of our sun is not due to its absolute magnitude, for other stars are heavier, nor to its brilliancy, for there are other stars which yield more light. The importance of the sun is simply due to the fact that the earth is comparatively close to it, while the nearest star is at least 200,000 times as far away. [See STAR.] The mode in which the sun's distance from the earth has been measured by means of the transit of Venus is described under VENUS.

SUN AND FIRE WORSHIP. The magnificence of the sun, and the vast importance to mankind of its light and heat have undoubtedly from the earliest times caused it to be regarded as associated with the Supreme Deity, or to be in itself an object of devotion and reverence. Much obscurity rests over the early history of mankind, but it is now fully established that the worship of the sun, or of the sun-god, was at a very remote antiquity almost universal, and traces of its existence are to be found in connection with nearly all the great religions of earlier times. Thus the ancient Hindus adored the heavenly bodies, worshipping the gods of the sun, moon, stars, fire, &c., as may be seen from the hymns of the Rig-Veda. The Egyptians adored Ra, the sun-god, as the principal object of worship, and seem to have regarded him as a type of the Supreme Deity. In the monuments he is represented as a hawk-headed man having the sun disc on his head, or when presented as Amen-Ra, or the god of mind and force, with a human face. The Babylonians placed the sun-god among their seven chief deities, but unlike most worshippers of the heavenly bodies they appear to have given him an inferior place to the moon-god. The Arabians at an early period appear to have paid direct worship to the sun without the intervention of any statue or symbol, and this simple style of worship was probably common throughout most of the surrounding countries. The Hebrews must have been acquainted with sun worship from the earliest periods of their history as a people, for the district they occupied when living under the protection of the Pharaohs was in close proximity to On=the Hebrew Bethshemesh, "house o the sun." During later stages of their history, after they had obtained a settlement in Palestine, they came into contact with several forms of worship that had originated in the adoration of the sun, as we may learn from the frequent references in the Old Testament to the adoration paid to the Phœnician Baal, Syrian Tammuz, the Molech or Milcom of the Ammonites, and the Hadad of the Syrians. A reference to the more simple adoration of the sun itself is also to be found in Job xxxi. 26-29. In the mythology of the ancient Greeks we find the sun-god in Apollo, while the Romans had the double-faced Janus, looking eastward and westward, the opener and closer of the day, the beginning and end of all created things. Janus was invoked at the beginning of most acts of worship and sacrifice, he was worshipped every morning as the father of the dawn, the gates of his temple during war were ever open as a refuge, and the first month of the year was sacred to him, and still, though he has long been dead, does it bear his name. In Iran or Persia sun-worship lingered long and attained a high development:—

> "Where are the days, thou wondrous sphere,
> When Iran like a sun-flower turned
> To meet that eye where'er it burned?
> When, from the banks of Bendemeer
> To the nut-groves of Samarcand,
> Thy temples flam'd o'er all the land?"

There are still numerous remains of the ancient temples of the sun and of fire extant in Baluchistan, and the modern survival of the primitive faith is noticed under PARSIS. For the highest and most complete development of sun-worship, however, we must turn to ancient Peru, at the epoch of its discovery by the Spaniards. The government of the country was entirely theocratic—the Incas, or sovereigns of Peru, claiming adoration and obedience on the ground of their being the children of the sun and his representatives on earth. A gorgeous temple of marble and gold was raised for the worship of the sun in Cuzco, the capital, the most prominent object in which was a huge representation of the sun's disc and rays in solid gold, so placed that the rising sun shining in at the open east end of the temple fell full upon it, the reflection received and returned by shining plates of gold, filling the place with dazzling splendour. At the summer solstice was celebrated a great annual festival, when the multitude, as soon as the first rays of the sun kindled on his golden image in the temple, threw themselves upon the earth and silently adored. In Peru all the actions of life were regulated by the apparent motions, phases, and phenomena of the solar orb, while the moon was worshipped as his spouse, Venus as his page, and the rainbow and lightning as his servants.

In many forms of sun-worship the adoration of fire, the earthly source of light and heat, has been associated with that of the heavenly body, or both have been regarded as manifestations of one deity. The widespread use of fire in divine worship has been noticed under SACRIFICE. Among the many ideas which have grown out of the origina sun-worship, and which have been associated with it, the more prominent are those which have connected it with the reproductive force of nature, a conception too often degenerating into nameless impurity and sensuality, and those which grew out of fear and terror, and led, in many instances, to the offering of human sacrifices. (See Helps' "Spanish Conquest of America;" Max Müller's "Comparative Mythology," and "Oxford Essays;" and Rev. G. Cox, M.A., "Manual of Mythology.")

SUN-ANIMALCULE. See ACTINOPHRYS, HELIOZOA.

SUN-BEAR. See BEAR.

SUN-BIRD (Nectarinidæ) is a family of passerine birds belonging to the group Tenuirostres. They are birds of brilliant plumage, representing in the Old World the Trochilidæ or humming-birds of America. The sun-birds have the bill long and very slender, curved, with the edge of the two mandibles finely serrated, and the tongue, which can be protruded from the bill, terminating in a fork. The nostrils are placed at the base of the upper mandible, and covered by a scale. The wings are of moderate length, and the tarsi are short, covered with broad scales. They are small birds, and the plumage of the male glitters in the breeding season with metallic colours, approaching in splendour that of the humming-birds. They are found principally in Africa, India, and the Malay Archipelago. Their nature is gay and their song agreeable. They feed on small insects, for which they search with their long slender bills among the petals of flowers; they also feed to some extent upon the juices of flowers. Many of them construct beautiful pensile nests. The species are numerous, but they all agree generally in their habits.

The Blue-throated Sun-bird (*Nectarinia zeylonica*) is an abundant species in Bengal, and occurs also in other

parts of India, in Ceylon, and the Indian islands. It measures about 4 inches in length, and has the plumage of the upper parts olive, and that of the lower surface yellow; the throat, the front of the neck, and the breast are of a brilliant violet-blue colour. It has a weak, shrill song, compared by Mr. Blyth to that of the British hedge-sparrow. The nest is pensile, and has the entrance at the top. Mr. Blyth describes a specimen in his possession as a beautiful fabric. It was attached nearly throughout its length to a small thorny twig, and was of an elongated pear shape, composed of soft vegetable fibres, very neatly interwoven, with coarser strips of grass, leaves, and fragments of bark on the outside. The inner lining was composed of the softest fibres, which were carried over the lower part of the entrance so as to fasten down its rim, and over the entrance was a roof or canopy. The Hindus of the vicinity of Calcutta take these birds with bird-lime, and after plucking out the wing primaries to prevent their fluttering, tie them to a stick and carry them about for sale.

The Jericho Sun-bird (*Cinnyris osea*) occurs in Palestine, where it is often mistaken by travellers for a humming-bird. The Cape Sun-bird (*Promerops caffer*), a native of the Cape of Good Hope, is the representative of a genus with a long wedge-shaped tail. It is about 15 inches long; the plumage of the upper parts is greenish-brown, the breast is brownish-orange, and the lower parts white, spotted with brown. This species feeds on the juices of flowers, especially those of the Protea.

SUN'DA ISLANDS is a term generally applied to the western and larger portion of the Indian Archipelago. They are divided into two groups, the Greater and the Lesser Sunda. For the Greater, see BORNEO, CELEBES, JAVA, and SUMATRA, with their dependencies BANCA, BILLITON, and MADURA.

The Lesser Sunda Islands consist of four large groups, which, from west to east, are called the TIMOR, the Serawatti, the TENIMBER, and the ARROO Islands. The term is frequently applied to the TIMOR group alone—so called from the most important of them—which extend from 114° to 127° 30′ E. lon., and comprehend the largest of the whole chain. The chief islands after Timor are SUMBAWA, Bally, and Lombok. Among the smaller ones are Comodo, Gilibanta, Goonong Apec, Flores, Solor, Adinara, Sebrao, Lomblen, Pantar, Ombay, Wetter, Sumba or Sandalwood, Savu, Rotti, and Simao. The climate is very hot, especially during the dry monsoon, from May to November, when the thermometer often rises to 94° in the shade. Contiguous to the sea, however, in most of the islands, there are very fertile lands. The principal products are maize, millet, rice, pulse, sweet potatoes, cotton, tobacco, sugar, and various kinds of tropical fruits. There are several varieties of palms and other useful timber trees, and indigo grows everywhere. Most of the group are more or less under the control of the Dutch.

SUN'DA, STRAIT OF, a well-frequented thoroughfare between the Indian Ocean and the China Sea, is often navigated by vessels which proceed from the Atlantic to the islands of the Indian Archipelago and the eastern countries of Asia. It extends between 5° 40′ and 6° 50′ S. lat., and between 104° 55′ and 106° E. lon., from S.W. to N.E. Its northern shores are formed by the southern coast of Sumatra, and its south-eastern by the western parts of Java. Its length is about 100 miles, and its breadth varies from 20 to 90 miles.

SUN'DARBANS, THE, a vast tract of forest and swamp, forming the southernmost portion of the Gangetic Delta, Bengal; extends along the sea-face of the Bay of Bengal, from the estuary of the Hugli to that of the Meghna. The Sundarbans occupy an area of 7532 square miles; their extreme length along the coast is about 165 miles, and their greatest breadth from north to south about 81 miles. The country is one vast alluvial plain, where the continual process of land-making has not yet ceased. It abounds in morasses and swamps, now gradually filling up, and is intersected by large rivers and estuaries running from north to south. These are connected with each other by an intricate series of branches, and the latter in their turn by innumerable smaller channels; so that the whole tract is a tangled network of streams, rivers, and water-courses, inclosing a large number of islands of various shapes and sizes. It is bordered by a fringe of reclaimed land situated along the northern boundary, except in Bakarganj, where some of the clearings extend almost down to the sea. These reclaimed tracts are entirely devoted to rice cultivation. There are no villages, in the ordinary acceptation of the word; and the cultivators live far apart in little hamlets among their fields. The unreclaimed portion of the Sundarbans near the sea consists of impenetrable jungle and thick underwood, traversed by gloomy-looking water-courses. This thick jungle forms an admirable protection against the storm-waves which sometimes accompany cyclones in the Bay of Bengal. The wild animals found in the Sundarbans are tigers (which are very numerous, and cause much havoc, often seriously interfering with the work of reclamation), leopards, rhinoceroses, buffaloes, hogs, wild cats, deer of several varieties, porcupines, otters, monkeys, &c. Fish abound; and the python, cobra, and many other kinds of snake are found. Among the birds of the Sundarbans are adjutants, vultures, pelicans, kites, hawks, owls, doves, green pigeons, parrots, paroquets, jungle-fowl, kingfishers, jays, orioles, snipe, teal, pheasants, plover, partridges, and every description of water-fowl.

The name Sundarban has been variously explained, some deriving it from Hindu *sundar*, beautiful, and *ban*, forest; others from *sundri*, which is the commonest tree in the jungles. *Sundri* simply means beautiful, but the word has been connected by some writers with *sindur*, vermilion, the wood being of a reddish colour. A much less probable derivation traces the word to Chandrawip, the name of an old *zamindari pargana;* while, according to another but altogether unlikely etymology, the tract took its name from the Chandabhandas or Shandabhandas, a tribe of salt-makers. The extension of the name to the whole coast is modern. It has long been a disputed point whether the Sundarbans were formerly inhabited. Remains of buildings—houses and *ghats*—have been found in isolated parts of the jungle, showing that at any rate there were occasional settlers in those parts. But no evidence has yet been obtained to prove that the tract south of the present limit of cultivation was, as has often been asserted, at one time studded with towns or villages. It seems, on the contrary, probable that the northern limit has remained for about 400 years where it is at present. A very remarkable depression of the surface appears to have taken place at some not very distant period, large *sundri* trees having been found (not only in the Sundarbans, but as far north as Sialdah, a suburb of Calcutta) standing as they grew, at depths varying from 10 to 30 feet below the present level of the country.

Reclamation of the Sundarbans.—The earliest historical attempt to reclaim the Sundarbans was made by Khan Jahan, a Mohammedan chief who died in 1459 A.D., and whose clearings at Bagherhat in Jessor remain to this day. The more recent attempts date from 1784, when Mr. Henckell, the first English judge and magistrate of Jessor, inaugurated the system of reclamation at present existing. The principal staple of the Sundarbans is rice, of which two crops (*aus* or autumn, and *aman* or winter harvest) are raised in the year; the former, however, is only cultivated to a very limited extent. The cultivators grow a few other crops—vegetables, pulses, &c.—for home consumption. Sugar-cane and *pan* are cultivated in the

Bakarganj Sundarbans; and successful attempts have been made to grow jute. Cyclones in the Bay of Bengal, and the storm-waves which sometimes accompany them, are the only natural calamities to which the Sundarbans are subject. The inlying tracts are to a great extent protected from the effect of these storm-waves by the belt of thick jungle near the sea, as well as by the sandhills formed along the coast by the heavy silt-laden swell which rolls shoreward during the south-west monsoon.

The Sundarbans waterways are of the first importance, as being the chief means of communication between Calcutta and the East. Not only the jungle produce of the Sundarbans, but also the rice, jute, and oil-seeds of all Eastern and Northern Bengal, as well as the tea of Assam and Cachar, are carried by one or other of these routes. Nearly all the innumerable cross channels which divide the Sundarbans into a network of islands are navigable; but traffic naturally follows certain defined routes, which are themselves liable to change, as old streams silt up and new channels open out year by year. The Calcutta and South-eastern State Railway, originally intended to connect Calcutta with Port Canning on the Matla, may, since the abandonment of that port, be regarded as merely a means of local communication through the Sundarbans. Its total length is only 28 miles, and the traffic is almost entirely confined to the conveyance of firewood and a little rice to Calcutta. It was purchased by government in 1868, by repayment of the capital that had been expended by the guarantee company.

SUNDAY (Old English *Sunne dæg*; being so called because the day was anciently dedicated to the sun or to its worship), the first day of the Christian week, a day consecrated to rest from secular employments and to religious worship. It is called also the Lord's Day. Many pious persons, however, discard the word Sunday and employ the term Sabbath, which is quite a perversion of the meaning. Sabbath is the rest day at the close of the week, namely Saturday, and its whole meaning and symbolism are destroyed if it is applied to the Lord's Day, which begins the week. The confusion arises from the fact that the reverence for the Sabbath has been quite superseded in Christian countries by the reverence for the Lord's Day or Sunday. In Italy the name of Saturday (*Sabato*) preserves its proper meaning.

SUNDAY SCHOOLS. The use of Sunday schools as a means of imparting religious instruction dates from a very early period in Christian history, schools of catechumens being organized, according to Tertullian, in A.D. 180. The schools of the catechumens flourished till the sixth century. In 1527 Luther established Sunday schools in Wittenberg for the instruction of children who could not attend the day schools, and in 1560 Knox inaugurated them in Scotland. In 1580 Archbishop Borromeo of Milan established a system of Sunday schools throughout his diocese, and abou he same time similar schools were opened in France and the Netherlands. The schools thus established, however, failed to acquire permanence, and though subsequently many pious individuals arose who gave instruction to children on Sundays, it was not until near the close of the eighteenth century that Sunday schools were systematically organized for the religious instruction of young persons. In the year 1780 ROBERT RAIKES, a pious printer of Gloucester, was led to attempt something on behalf of the neglected children of that city. His heart had bee touched by the sight of groups of ragged and dirty children, who in the lower parts of the city spent the Sunday in rude sports and in acquiring evil habits, and he engaged four women who kept dame-schools to instruct as many children as he should send them on Sundays in reading and the church catechism, paying the teachers a shilling a day for their labours. The children were taught from 10 a.m. until noon, then after an hour's interval for dinner they read a lesson and attended church, after which they repeated the catechism until five o'clock, when school was over for the day. Gratuitous instruction in reading seems to have had an attraction for the parents, children being readily sent to school, and a marked improvement in the manners and conduct of the latter soon became visible. Raikes published an account of his work in the *Gloucester Journal*, of which he was proprietor, in 1783, and this account being republished in the *Gentleman's Magazine* in 1784, with a letter from Mr. Raikes, public attention was drawn to the subject, and other schools upon the same plan were quickly established in the principal towns of England. Scotland had similar schools as early as 1782, and they were established in Ireland in 1785. Once established the benefits conferred by the Sunday schools were so manifest that a society under high patronage was formed in London in 1785 for their establishment throughout the kingdom, and this society during the next fourteen years expended £4000 in payment of teachers. In 1786 the Methodists of Bolton introduced the important change of the employment of volunteer instead of paid labour, and the same year Bishop Asbury established a Sunday school in America. The Gratis Sunday School Society was established in Scotland in 1797, and voluntary teaching had become fairly general in England by 1800. In 1803 the Sunday School Union, chiefly composed of dissenters, was formed, and this was followed in a few years by the Institute of the Church of England, a Sunday School Society for Ireland being established in 1816. At first some of the ecclesiastical authorities frowned upon the system, and this was especially the case in Scotland, where Sunday schools were opposed for many years by portions of the church courts, but the powerful championship of Dr. Chalmers was enlisted on their behalf, and soon the churches both of England and Scotland began to assume charge of the schools, the instruction becoming more exclusively religious. In the United States the Methodist-Episcopal Conference at Charleston resolved to establish Sunday schools for whites and blacks as early as 1790, and by degrees this example was followed by the Protestant churches of all denominations in America, the Roman Catholics and Quakers adopting the system later. The New York Sunday School Union was formed in 1816, and the American Sunday School Union in 1824, the object of these societies being to promote the instruction of teachers, to assist in planting schools where they were needed, to promote cordiality and fellow-feeling among all who were engaged in the work, and to insure the publication of such tracts and books as were needed. The work thus established in America has been since carried on with characteristic energy and thoroughness, and for many years the Sunday schools of the United States have been the most elaborately organized and furnished of any in the world. With respect to the continent of Europe, Sunday schools upon the English system have been introduced into nearly all the Protestant countries and into many of the Protestant churches in Roman Catholic countries. In Germany schools were first established by Onken in 1824 in connection with the sailors' service at Hamburg; in the Netherlands by Dr. Capadose in 1837; and in Sweden by M. P. Palengoist in 1851. About 1850 the Sunday school movement on the continent of Europe received an immense impetus through the labours of Mr. Woodruffe, an American gentleman who devoted himself to the work of spreading Sunday schools there, and they are now firmly established in France, Italy, Switzerland, Norway, and Denmark, and have even found a place in Austria.

In regard to the work of the Sunday school, as day schools became available for the poorer classes of children secular teaching gave way to religious instruction, and it is solely as religious institutions that Sunday schools are now established and sustained. From the time when this

change was effected, systematic Bible instruction has formed the chief work of the schools, to this being commonly associated the teaching of the church or denominational catechism, the work being effected by means of a staff of male and female teachers, headed by a superintendent with various assistants. For the use of the teachers the different unions issue books and papers explaining the Bible lessons, and publish also lesson leaflets, &c., in immense numbers for the scholars. To further this department of the work, the American Sunday School Associations introduced in 1866 an international lesson system, in accordance with which all those portions of the Old and New Testament Scriptures that are suited for children's instruction are utilized in a period of seven years, and all schools are invited to use the common list, the different churches furnishing their own comments upon the subject matter. Among the many advantages of this system, which has been largely adopted in England since 1872, as well as on the Continent and in the mission stations of the East, one of the most important is that it has enlisted the services of some of the ablest ministers in the preparation of hand-books, notes, illustrative lessons, &c., for the use of Sunday school teachers. With respect to the statistics of Sunday schools, most of the religious denominations of England and America now return the number of scholars and teachers in their annual returns, and lists of numbers are also given in the annual reports published by the different Sunday school unions. At the Sunday school centenary services, which were observed with great enthusiasm in England in 1880, the figures prepared by the Sunday School Union of London showed that in that year there were in the United States about 6,000,000 of scholars, taught by about 1,000,000 of teachers; in the United Kingdom and the British colonies there were 4,500,000 scholars and 500,000 teachers; on the continent of Europe it was estimated there were about 400,000 scholars and 20,000 teachers; while in the mission stations in Asia, Africa, and Polynesia there were about 200,000 scholars taught by about 5000 teachers.

There can be no question that the Sunday school movement has exercised an immense influence for good in all the countries and among all the churches where it has been established. The teaching of poor children on Sunday did much to prepare the way for regular and systematic instruction during the week, so that the Sunday school may fairly be regarded as the precursor of the modern all-important elementary day school. The movement also, soon after its foundation, led to the formation of the British and Foreign Bible Society, and the Religious Tract Society, while home and foreign missionary work has been largely aided and supported by the revenue derived from Sunday school teachers and scholars. Further, it may be claimed for the Sunday school system that in addition to its directly religious and philanthropic influence, it has given a most wholesome, moral, and intellectual stimulus to those who have in such large numbers been enlisted for the work. The effort to teach has led the teacher to acquire knowledge, and to meet his requirements libraries have been formed, large numbers of books have been compiled and written, and an extensive periodical literature has been established. Sunday school publications are now also issued by regular business houses, as well as by church bounds and tract societies.

SUNDAY TRADING. In the United Kingdom legislative action has frequently been invoked to insure a stricter observance of the Sunday, and there are numerous statutes for the regulation of Sunday trading. Of these, perhaps the most important is the 29 Car. 2, c. 7, which provides that no action can be brought for the price of goods sold on a Sunday in the ordinary course of the trade or business of the vendor, unless the sale is within the exception of the Act, which permits food to be dressed and sold at inns and victualling houses to persons who cannot be otherwise provided for, and also of the sale of certain perishable articles of food. Penalties are also provided for a contravention of the regulations laid down by tradesmen, artificers, workmen, and labourers; but it has been decided that this definition does not include coach proprietors, farmers, attorneys, or surgeons. In Scotland the Forbes Mackenzie Act closes on the Lord's Day all houses licensed for the sale of intoxicating liquors, except to *bonâ-fide* travellers, and a similar Act was passed for Ireland in 1878, exempting, however, the five largest towns. Public houses are also closed in Wales on Sundays. In England they are permitted to open between the morning and afternoon service, and after the latter until ten or eleven p.m. Of the numerous other statutes passed for the restriction of Sunday trading, amusement, &c., the operation of many is limited by the influence of public opinion, the tendency during recent years being rather in the direction of greater liberty than otherwise, though there is a strong disposition on the part of the majority of the nation to maintain the day as a "rest day" as far as possible.

SUNDERLAND, a municipal and parliamentary borough and port of England, in the county of Durham, 269 miles N. by W. from London, 12 miles S.E. from Newcastle-on-Tyne, and 12 miles N.E. from Durham, is situated at the mouth and on both sides of the river Wear. The largest part of the town is on the south side, and comprises the parish of Sunderland and the townships of Bishopwearmouth and Bishopwearmouth-Panns. On the north side of the river are the townships of Monkwearmouth, Monkwearmouth-Shore, and Southwick.

Monkwearmouth was a place of some note in the Anglo-Saxon and Anglo-Norman periods. And at a monastery existing there in 674, the Venerable Bede spent the greater part of his life. The export of coals from the Wear to Whitby is recorded in 1395. Towards the close of the reign of Elizabeth the shipping of coal to London began to assume considerable importance, and Bishopwearmouth increased considerably, the chief exports being sea-coals, modern coal, grindstones, rubstones, and whetstones. In 1634 it received a new charter of incorporation from Bishop Morton. The parish of Sunderland, formed in 1719, by detaching a part of Bishopwearmouth, occupies the point of land at the south side of the mouth of the Wear. There is one street, broad and handsome, consisting of the High streets of Sunderland and Bishopwearmouth, extending about a mile in length, and lined with good houses; many of the other streets in Sunderland parish are narrow and very densely peopled. Bishopwearmouth was formerly a distinct town from Sunderland, but the progress of building has now united them. The most modern part adjoining Sunderland has good streets and excellent houses, in which the wealthier classes reside. Bishopwearmouth-Panns comprehends a small part on the bank of the river; it has glass-houses, shipbuilding yards, and works for the manufacture of articles required by the shipping. Monkwearmouth-Shore is immediately opposite Sunderland and a part of Bishopwearmouth; it has a dense population. Monkwearmouth adjoins Monkwearmouth-Shore, but lies back from the river. On the bank of the river, half a mile higher up than Monkwearmouth, and extending inland, is Southwick, which is included in the parliamentary borough. In it are some shipbuilding yards, bottle works, and glass works; the greater part of the township, however, is agricultural. Great improvements have been affected in Sunderland, and it is now much healthier than formerly, though much remains to be done. Public fountains and baths have been erected.

The river is crossed by a noble iron bridge of one arch, erected near the close of the last century. The abutments are piers of nearly solid masonry 24 feet in thickness,

The arch is of iron. and forms the segment of a large circle, having a span of 236 feet; the height above low water is 60 feet to the spring, and 94 feet to the centre of the arch, so that vessels can pass under it very readily by lowering their top-gallant masts. The superstructure is of timber planked over, with flagged footpaths and iron balustrades. The bridge was repaired and widened to 30 feet in 1858, under the direction of Robert Stephenson. It is also crossed by a high-level bridge belonging to the North-eastern Railway Company.

Sunderland Church is a spacious modern brick building, with a square tower. The church of Bishopwearmouth was much altered in the early part of the present century; the chancel is ancient, and has a fine east window. Monkwearmouth Church is a mutilated and irregular building, but has, especially in the tower, some very ancient features. There are several episcopal chapels, and about forty places of worship for dissenters and Roman Catholics.

Sunderland contains some handsome municipal buildings erected in 1887, with a fine tower over the central entrance; a custom-house, excise-office, county court, police court, and exchange (the last comprises a merchants' walk, commercial room, news room, auction mart, and telegraph office), two theatres, music hall, assembly-room, athenæum, free library, Donnison's and Walton's Schools, sailors' home, school of design, school of industry, orphan asylum, aged seamen's and other almshouses, girls' reformatory, and general, eye, and children's diseases infirmaries. The public park is 24 acres in extent. It commands a good view of the sea, and contains a fine statue of Sir Henry Havelock, who was a native of the town. A statue of Mr. Candlish, a former M.P. for the town, was erected in 1875. The village of Roker, about a mile from Sunderland, is resorted to for sea-bathing.

The preservation and improvement of the port of Sunderland are entirely owing to the exertions of commissioners who have been appointed under successive Acts of Parliament for levying certain dues and applying them to the cleansing and improving of the harbour. These works, and particularly the construction of piers on both sides of the mouth of the river, have had so great an effect that ships drawing 18 feet of water can now enter the harbour. The piers extend upwards of 600 yards in length from the sides of the mouth of the river into the German Ocean. On the south side of the river are very extensive wet docks, altogether about 75 acres in extent, much of the area of which has been reclaimed from the sea, with from 3 to 4 fathoms of water. The Hendon Dock is 11 acres in extent. It was opened in 1868, and is fitted with the most approved appliances of every kind. There is likewise a small dock on the north side. The harbour is defended by batteries. There is a considerable fishery near the town.

Both wood and iron shipbuilding are carried on to a very great extent. The principal manufactures are of bottle and flint glass, anchors, chain cables, and other iron goods for ships, and cordage. There are also sailcloth manufacturers, and rope, sail, mast, block, and pump makers. Some of the ropewalks are on a very large scale. Brickmaking, coal-mining, and the quarrying of grindstones are carried on in the neighbourhood; and there are copperas works, brass foundries, potteries, hat manufactories, lime works, timber yards, saw and flour mills, tanyards, and breweries. The town is, however, more important from its commerce than its manufactures. In shipping coal it ranks among the chief ports of the kingdom. The exports of lime, glass, and grindstones are other principal branches of commerce. The imports are timber and iron from the Baltic; butter, cheese, and flax from Holland; and a variety of goods brought coastwise. The number of vessels registered as belonging to the port in 1887 was 360 (230,000 tons). The entries and clearances each average 9,500 (2,800,000 tons per annum).

The municipal borough is divided into seven wards, and is governed by sixteen aldermen (of whom one is mayor) and forty-eight councillors. The parliamentary borough, which returns two members, comprises the parish of Sunderland and the several townships of Bishopwearmouth, Bishopwearmouth-Panns, Monkwearmouth, Monkwearmouth-Shore, and Southwick. Its population in 1881 was 124,811. That of the municipal borough increased from 98,335 in 1871, to 116,548 in 1881.

South of Sunderland is the largest colliery estate in the world belonging to a single individual. It consists of not less than 12,000 acres, and annually yields over 1,000,000 tons of coals. It is the property of Earl Vane. Pemberton's pit, a mine at Monkwearmouth, on the north of the town, reaches 1710 feet below the surface, and is one of the deepest mines known.

SUNDEW. See DROSERA.

SUN-DIAL, an instrument for measuring time by the motion of the sun's shadow, cast by a style erected on its surface. Up to a comparatively recent period the science of constructing sun-dials, under the name of Gnomonics, was an important part of a mathematical course. As long as watches were scarce and clocks not very common, the dial, which is now only a toy, was in actual use as a timekeeper. Of the mathematical works of the seventeenth century which are found on book-stalls, none are so common as those on dialling. All that is now necessary is to give some idea of the principles on which such instruments are constructed, as an illustration of a leading fact in astronomy.

If a person were to place a staff in the ground, so as to point either vertically or otherwise, and to watch its shadow at the same hour, on different days at some intervals from each other, marking its direction at each day's observation, he would in all probability find that the direction of the shadow, the hour being always the same, varied from day to day. He might, however, find that the shadow was always in one direction at the same hour, and this might happen in two different ways. First, he might by accident fix the staff in a direction parallel to that of the earth's axis, in which case the direction of the shadow would always be the same at the same hour, at all times of the year, and for every hour. Secondly, having fixed the staff in a position not parallel to the axis of the earth, he might happen to choose that particular hour, or interval between two hours, at which the shadow of a staff in that one direction always points one way. But if, as is most likely, he were to fix the staff in a direction which is not that of the earth's axis; and if, as is again most likely, he were to choose any time of observation but one, the shadow would certainly point in different directions at different periods. A curious instance of the importance of correct dialling is given by the first sun-dial erected in the Forum at Rome, B.C. 263. This had been prepared for Catana, 4 degrees further south, and it was a whole century before the absurd error was discovered and rectified.

A sun-dial consists of two parts: the style, or gnomon, which is the staff above-mentioned, usually supplied by the edge of a plate of metal, always made parallel to the earth's axis, and therefore pointing towards the north pole; and the dial, which is another plate of metal, horizontal or not, on which are marked the directions of the shadow for the several hours, their halves and quarters, and sometimes smaller subdivisions.

The dial is an instrument of great antiquity, the earliest mention made of it being in Isa. xxxviii. 8, about 713 B.C. It is now regarded rather as an ingenious curiosity than a philosophical instrument; the principal objections to it being that the shadow of the style is not sufficiently well defined to give very accurate results, even for ordinary purposes; that refraction, which always makes the sun appear a little too high, throws the shadow a trifle

towards noon at all times—that is, makes the time too fast in the morning, and too slow in the evening; and that a correction is always necessary to find mean or civil time. Even if the first objection could be got over, the corrections requisite for the two latter would prevent persons in general from making use of the instrument.

The general principle of dialling, however, may be rendered intelligible to the reader by a simple illustration. Thus, conceive *a* P B P (Plate, fig. 1) to represent the earth as transparent, and its equator as divided into twenty-four equal parts, or hour circles, by so many meridian semicircles, *a*, *b*, *c*, *d*, &c., one of which is the geographical meridian of any given place, as London, denoted by *a;* then, if the hour of twelve were marked at the equator, both upon that meridian and on the opposite one, those meridians would be the hour circles of London; because, as the sun appears to revolve round the earth in twenty-four hours, he will pass in an hour from one meridian to another. Consequently, if the sphere had an oblique axis, as P E P, terminated at the poles, P and P, the shadow of the axis, which is in the same plane as the sun and with each meridian, would fall upon every particular meridian and hour when the sun came to the plane of the opposite meridian, and would, therefore, show the time at London, and at all other places on the same meridian.

If now this sphere were cut through the middle by a plane, A B C D, in the rational horizon of London, one-half of the axis, as E P, would be above the plane and the other half below it; and if straight lines were drawn from the centre of the plane to those points where its circumference is cut by the hour-circle of the sphere, those lines would be the hour-lines for a horizontal dial stationed anywhere in London. The shadow of the axis or gnomon would fall on each particular hour-line of the dial when it fell upon the like hour circle of the sphere.

If the plane cutting the sphere be vertical (fig. 2), as A F C G, it will then become the plane of an erect south dial, and right lines drawn from the centre to those points of the circumference where the hour-circles intersect it, will be the hour-lines of a vertical or direct south dial for London, to which the hours are to be set in the figure contrary to those of the horizontal dial, and the hour point, P E, of the axis will cast a shadow on the hour of the day on that dial at the same time that it would fall upon the like hour-line of the sphere if such dial plane were not interposed.

We subjoin a few problems which may be of interest to the reader who would wish to pursue the subject of dialling further.

1. *To determine the requisites in a dial for any proposed latitude, and of given inclinations to a vertical plane, and at any given declination from the prime vertical* (see Plate, fig. 3).

Let H O B represent the horizon; H Z B, the meridian of the plane; Z, the zenith; Z O, the prime vertical; C, the elevated pole; P *b*, P *b*′, &c., portions of the hour-circles; Z P *b*, Z P *b*′, &c., comprehending hour-angles; and let the plane on which it is proposed to draw the dial be coincident with the plane of the great circle, M *b* S. Also let Z *a*, perpendicular to M *a* S, be drawn, and produced to I. Then P B = L, the latitude of the place; Z *a* = I, the inclination of the plane; O S = H I = D, the declination; P S, drawn perpendicular to M S, will be the position of the substyle; and M *h* is the inclination of the hour-line to the meridian.

Now we may regard the dial, whose plane coincides with M *a* S, as a vertical or erect dial at the place whose zenith is M, where M and Z are on the same meridians; and, of course, reckon the hours alike. Let M Z = *l*, and D′ = comp. of Z M *a*. Then P Z = 90° − L would become P M = P Z + Z M = 90° − L + *l* = 90° − (L − *l*).

2. *To construct a horizontal dial for any proposed latitude* (see Plate, fig. 4).

This is a very simple construction, and very useful. It depends upon the following theorems:—

tan. M *b* = sin L tan P, and sin E = sin L.

M *b* is the measure of the angle H, between the twelve o'clock and any other hour-line on the dial, and P the hour-angle from the meridian. As it varies at the poles of the heavens, the latter therefore varies uniformly, while the former only varies uniformly in certain limited cases; as, for example, in the horizontal dial, in latitude 90°. In any other latitude, making the hours of the case homogeneous, we have sin 90° tan. H — sin L tan. P. Hence, if two radii be assumed in the ratio of rad. or sin 90° to sin L, tan. H, as referring to the former radius, will always be equal to tan P, referred to the latter. From this consideration, the following construction is deduced:—

On the proposed plane assume the right line 12 H S, for the meridian or twelve o'clock hour-line, parallel to which draw the line 12 *h* S, at a distance equal to the proposed thickness of the style. Perpendicularly to these draw 6 H 6 for the east and west line of the dial, or the six o'clock hour-line. Make the angle 12 H F = the latitude of the place, and from 12 let fall the perpendicular 12 F upon H F. Make 12 P upon H 12 prolonged, equal to 12 F. From P draw lines P 1, P 2, P 3, &c. (to terminate in the line 12-5, perpendicular to 12 H), and to make the angles 12 P 1, 12 P 2, 12 P 3, &c., equal to 15°, 30°, 45°, &c. Then from the centre H draw H 1, H 2, H 3, H 4, H 5, for the hour-lines of 1, 2, 3, 4, 5, in the afternoon. Take, on the other side of the substylar line, 12-11, 12-10, 12-9, &c., respectively equal to 12-1, 12-2, 12 3, &c., and from *h* draw the lines *h* 7, *h* 8, *h* 9, &c. Produce the lines 4 H, 5 H, for the lines of four and five in the morning; and produce the lines 7 *h*, 8 *h*, for the hour-lines of seven and eight o'clock in the afternoon.

3. *To describe an erect direct south dial, for any proposed north latitude; or an erect direct north dial, for any proposed south latitude.* (Fig. 5.)

Here the formulas on which we proceed are—

tan. M *b* = cos L tan. P, and sin E = cos L.

Substituting H for M *b* in the former of these, and making the terms homogeneous, we have—

sin 90° tan. H = cos L tan. P.

As this equation is similar to the equation of the hour-angles in the horizontal dial, the construction will be similar, except that the cosine L is here to be employed instead of sin L.

On the proposed plane draw the right line 6 H 6, for the east and west line of the dial, or the hour-line of 6. In the middle of this line set *h* H, equal to the proposed thickness of the gnomon, and through *h* H draw lines perpendicular to 6 H 6, to terminate in the line 9-5 parallel to 6 H 6; at a convenient distance draw H F to make the angle 12 H F equal to the latitude of the place for which the dial is made, and let fall upon H F the perpendicular 12 F. Make 12 P = H F, the cosine of the angle 12 H F to radius H 12; draw from P, lines P 1, P 2, &c., to make angles of 15°, 30°, &c., with P 12; draw lines from H to meet these in the line 9-5; set off corresponding lines on the left side of the dial, and the construction is completed. The demonstration is the same as in the last problem. The angle made between the style and substyle is here equal to the complement of the latitude. When the dial is placed vertically to face the proper cardinal point, the line 6 H 6 will be horizontal, and the style sloping downwards from H, at an angle = 90° − L,

will again be parallel to the world's axis, as it ought to be.

4. *To describe an erect direct east dial for any proposed north latitude; or an erect direct west dial for any south latitude.* (Fig. 6.)

Let A B be assumed as the horizontal line on the proposed dial. From the angle B draw B D to make an angle A B D = the complement of the latitude; and about the middle, H, of that line draw perpendicularly to it the line, 6 H 6, for the six o'clock hour-line; this will also be the substylar line, and will evidently make with the horizon an angle B 6 H = the latitude of the place. Assume any point, as that marked 11, for the point where the eleven o'clock hour-line is to intersect the line B H; and draw 11 P to make the angle H 11 P = 15°; so shall P H be the height of the gnomon. Set off angles H P 7, H P 8, H P 9, &c., respectively equal to 15°, 30°, 45°, &c., and through the points where the lines P 7, P 8, &c., intersect the line B D, draw lines parallel to P H. Also set off from H, towards D, H 5 = H 7, H 4 = H 8, &c., and through the points 5, 4, 3, &c., draw other lines parallel to P H; these shall be the hour-lines required.

SUN-FISH (Orthagoriscus) is a genus of fishes belonging to the order PLECTOGNATHI, nearly allied to the GLOBE-FISHES (Diodon, &c.), forming, according to Günther, a subfamily Molina, of the family Gymnodontes. The body is very short and compressed, covered with a rough or tesselated skin, and not capable of inflation, as in the globe-fishes. The pectoral fins are of moderate size, and the ventrals are absent; the dorsal and anal fins, both of which are long, are united with the caudal, and thus surround the hinder portion of the fish, which appears as if it had been truncated. The jaws are provided with a cutting edge of bone covered with enamel, which is undivided in the middle, and takes the place of teeth. There is no air bladder. The vertebral column is remarkably short, the total number of vertebræ being seventeen, of which seven belong to the tail. The spinal cord is still further reduced, forming a mere appendage to the brain. The Common Sun-fish (*Orthagoriscus mola*) has been found on various parts of the British coast during the summer, when it is usually seen floating on the surface, as if basking in the sun. When captured these fishes utter loud grunting noises. They feed on small crustaceans found on the surface of the ocean, and also on seaweeds and corallines. The flesh is white and well-flavoured, tasting like that of the crab, according to Couch. The liver yields a large quantity of oil, which is valued in Australia, and is often used for lubricating purposes on board ships, and as a remedy for sprains and bruises among fishermen. The sun-fish inhabits the open sea, and is found in most temperate and tropical waters. It grows to a very large size, attaining sometimes a length of 7 or 8 feet, and a weight of as many hundredweights. The back and fins are generally blackish, and the belly silvery-white. The skin is rough and minutely granulated. The proportions of the body undergo remarkable changes with age. In the young the body is somewhat globular, the vertical diameter exceeding the longitudinal, and has small conical spines scattered over it. As growth progresses the body elongates, till in adult specimens the depth is about half the length.

The Oblong Sun-fish (*Orthagoriscus truncatus*) is a rare fish, occasionally taken on British coasts; it is met with on the west coast of Africa, at the Cape of Good Hope, and in the Pacific. It is distinguished by its smooth tesselated skin and more elongated body, the proportion of the length to the depth being about three to one.

SUN-FLOWER is the English name of a genus of plants called Helianthus (from Gr. *hêlios*, the sun, and *anthos*, a flower). Two reasons have been assigned for giving the plants of this genus this name: first, the resemblance of the large disc and ray of their flowers to the sun; and second, the tendency of these flowers, in a stronger degree than in other plants, to present their face to the sun. From this circumstance the French *tournesol*, Italian *girasole*, and English *sun-flower* are names given to them.

The genus Helianthus belongs to the order COMPOSITÆ, and contains coarse tall herbs with large rough opposite or alternate leaves, and large yellow flower-heads, solitary or in corymbs, with an involucre of numerous leaves. The florets of the ray are strap-shaped, barren, and form a single row; those of the disc are tubular and perfect. The species are numerous, chiefly natives of North America.

Helianthus annuus (annual sun-flower) is an herbaceous annual plant, the largest of the genus. It is indigenous in tropical America, where it sometimes attains a height of 20 feet. It was early introduced into Europe after the discovery of America, and has since been very generally cultivated in gardens, on account of its very large and handsome yellow flowers. The plant, however, in Europe never attains the height nor the flowers the size they do in their native soil and climate. The albumen of the seeds contains a large quantity of oil; and it has been proposed to cultivate it for the sake of obtaining this oil, which is very palatable, and might be used for the table. The seeds are also used for making demulcents and soothing emulsions, and in some places are used as food for cattle and poultry. It is so exhaustive of the soil, however, that its cultivation is unprofitable. *Helianthus multiflorus* (many-flowered sun-flower) is not so tall a plant as the last, nor are its flowers so large. It is a native of Virginia. *Helianthus tuberosus* (the tuberous sun-flower or Jerusalem artichoke) a native of Brazil, was introduced into Europe at the Farnese Gardens at Rome, whence it was originally distributed. The roots are creeping, and produce towards the end of autumn a number of roundish or oval tubers, very large and fleshy, reddish outside and white within, resembling a potato. When cooked they form a good substitute for, and by some are even preferred to, that esculent. They were very commonly eaten in this country before the cultivation of the potato became general, but have fallen greatly into disuse. See JERUSALEM ARTICHOKE.

SUNGAI UJONG, the smallest of the three protected States of the STRAITS SETTLEMENTS, has an area of about 660 square miles, and is situated to the south of Selangor and north-west of Malacca. As in the case of Perak and Selangor, the intervention of the Straits Settlements government was called for by the quarrels between Sungai Ujong and the neighbouring State of Nembow, which led in 1874 to the stoppage of the navigation of the river Zingi, then the only highway between Sungai Ujong and the sea. A British resident was appointed to the State in 1874, and, with the exception of an invasion by the inhabitants of some of the neighbouring states in 1875, which led to the temporary occupation of those countries, its peace has since been assured. The population is small, consisting only of about 14,000 persons, of whom 10,000 are Chinese, the rest being Malays and natives of India. Arabian coffee and cinchona have been planted with success on the hills, and tapioca, Liberian coffee, cacao, and pepper are being successfully cultivated on the lowlands.

SU'NIUM, properly *Sounion*, the famous cape forming the southernmost point of Attica and the Athenian territory. Its modern name of Cape Colonni is given it from the fine remains of a once splendid temple of Athena, the patron-goddess of the great Ionian metropolis, standing boldly out on the rock some hundreds of feet above the sea. Sunium sighted, was to the sailors of Athens the same as Land's End or the Eddystone to our home-sick travellers: and many references of the kind are found in the ancients.

SUNN (*Crotalaria juncea*) is a leguminous plant, belonging to the suborder Papilionaceæ, a native of India, which is cultivated in that country and in other parts of Southern Asia, for the fibre of its inner bark. It is a shrubby annual, growing from 8 to 12 feet high, and presenting a general appearance to the Spanish broom. For purposes of cultivation the plants are sown close together to prevent branching as much as possible. The seed is generally sown about the commencement of the rainy season, and in three or four months time the plants are ready to be gathered. The plants are either cut down close to the root or are pulled up like hemp. The stems are steeped in water for three or four days to loosen the bark; they are then taken up in handfuls and bent so as to break the inner wood without injuring the fibre. The operator then strikes each part successively on the water until the fibre is entirely separated, when the filaments are hung up to dry, and afterwards combed. The fibre is very strong and considered equal to some kinds of hemp. Ropes made of it are much stronger when wet than when dry, so that it is particularly useful for cable, fishing nets, &c. It is also employed for making canvas, cloth, &c. It is variously known as sunn-hemp, brown-hemp, Bombay hemp, &c., and a variety produced at Jubbulpore as Jubbulpore-hemp. It is imported in considerable quantities into Great Britain. In Madras it is also grown as food for milch cows.

SUN-SPOT THEORY OF CLIMATE. Most meteorologists now trace a well-defined periodicity in changes of weather coinciding more or less closely with that of the changes on the sun's surface; although beyond the general fact that all the practically effective heat (*i.e.* almost all the active force) of the earth is derived from the sun, and therefore that any great change in the sun is likely to show results on the earth, no good theory of the exact mode of influence has been proposed.

The sun-spots vary from comparatively small areas to millions of square miles, and from large numbers to almost nil. Schwabe of Dessau began the systematic study of sun-spots in 1825, and continued it almost without intermission till 1867. His labours showed that the epochs of maximum, when the spots were largest and most numerous, were separated by regular intervals of about ten years, and also that the converse epochs of minimum were equally regular. More recent determinations indicate that the length of the period is more nearly eleven years.

It was Sir Edward Sabine who, in 1852, first pointed out the synchronism of the eleven-year magnetic periods with those of the sun-spot period; and large numbers of observations show that an exceptionally large sun-spot is always accompanied by magnetic storms all over the earth, in both the light and dark hemispheres. Brilliant displays of the aurora in regions of high and medium latitude are a feature of these magnetic storms; and a separate series of observations shows that the great auroral displays follow the sun-spot periods.

Meteorologists have also directed their attention to other terrestrial results, and especially to those of climate—their assumption being that the lessening of the solar influences through the darkening of large portions of the sun's surface, or contrariwise the augmentation of solar influence in consequence of the inconceivably vast development of solar energy which the spots represent, producing such marked magnetic phenomena as they admittedly do, should produce also meteorological phenomena of every other kind. Professor Balfour Stewart has actually demonstrated the periodicity of cyclones, rainfall, temperature, and barometry in eleven-year cycles following the sunspot cycles. An easier task is to survey the results of these climatic influences—namely, the floods, famines, harvests, vintages, &c. These also yield a like periodicity when the field of statistics is wide enough. Many other men of science have dealt and are dealing with this interesting subject, and some enthusiasts push it to great lengths. Even the attempt to show that the admitted periodicity of panics in banking and commercial circles follows the sun-spot cycles is not so absurd as it seems at first sight; for panics result from failing credit, and this is due to unhealthy inflation arising in the first instance from good harvests and other favourable cosmic influences. Trade increases by leaps and bounds; the unwise traders neglect to contract their operations when they should, so that a time comes when they are unsupported by the favourable cosmic influences, they fail to honour their engagements, and a widespread suspicion rapidly grows against which the firmest reputations are hardly safe.

SUNSTONE, an ornamental variety of FELSPAR having a golden, glittering appearance when viewed by reflected light, owing to the presence of numerous minute scales of oxide of iron. It is obtained at Tvedestrand, in Norway, and (rarely) in some other localities.

SUNSTROKE (also called *Insolation*, *Heat Apoplexy*, *Heat Asphyxia*, and *Solar Asphyxia*) is the name given to a common disease, which specially attacks persons exposed to the continuous hot rays of the sun or other sources of heat. It has been recognized from the earliest times, more especially in tropical countries, one or two cases being noticed in the books of the Old Testament (see 2 Kings iv. 18, 19, and in the Apocrypha, Judith viii. 3). It is common enough in India during the hot season, in other tropical countries, and in America; and it forms an item among the diseases peculiar to summer in Europe and in Great Britain. Soldiers marching or fighting when oppressed by weight of clothing and accoutrements are apt to suffer either from simple heat exhaustion or that form of sunstroke which results from the direct action of the sun on the head and neck, while workmen employed in heated engine-rooms, barracks, and hospitals in hot climates are liable to suffer from heat exhaustion, which may pass into the dangerous condition of fever or insolation. The symptoms of this disease vary considerably according to the extent and nature of the injury. In some cases the patient while engaged in marching or in work in the sunshine suddenly falls without warning, gasps convulsively, and dies in a few minutes from failure of the heart. Sometimes the attack is less sudden in its mode of onset, and there are premonitory symptoms giving notice of the coming danger for some hours, or it may be days, before the disease becomes manifest. The skin becomes dry and hot, the temperature of the body rising to 108°, 110° Fahr. or higher, while the nerve-centres generally, and especially the respiratory, suffer from over-stimulation followed by exhaustion. The patient breathes in a hurried gasping manner, complains of giddiness, weakness, nausea, thirst, and of an inability to hold his water, and as the disease progresses he becomes hysterical or delirious and dangerous to himself or others. After a time the patient often becomes insensible, the urine is suppressed, the heat and dryness of the skin augment, and after an attack of convulsions death ensues from asphyxia. In some cases the patient is not disturbed by convulsions during the later stages of the disease, but having passed into a state of coma he lies still, breathing heavily until he expires. The mortality from sunstroke is about 45 to 50 per cent., but of those who recover many are permanently injured and remain invalids for the remainder of life, which is often shortened by the changes induced. Persons who have suffered from sunstroke are often subject to persistent headache, impairment of memory, great nervous irritability, partial paraplegia, partial or complete blindness, epilepsy, and insanity.

For the prevention of sunstroke the skin should be kept clean by frequent bathing, and the natural perspiration should be encouraged as much as possible; the clothing should be light and loose, and the head and spine should

be protected by thin folds of white linen or serge, which may be kept wet if the heat is excessive. During exercise the neck should be perfectly free, and nothing should impede the free movements of the chest. The strength should be supported by a moderate amount of food, and any simple non-alcoholic beverage may be freely taken. All intoxicating liquors should be avoided, the use of ardent spirits being especially dangerous in cases of heat exposure.

With respect to the treatment of sunstroke where a person is struck down suddenly, he should be removed immediately into the shade, his clothes should be loosened and partially removed, and a douche of cold water should be allowed to fall in a stream over the head and body. If this treatment be quickly and energetically performed it may be speedily followed by returning sensibility and speedy recovery, and its efficacy may be increased by the application of ammonia, sal-volatile, or smelling salts to the nose, and the application of a blister to the nape of the neck. There are a few physicians who still maintain the usefulness of bleeding in sunstroke, but the great majority are strongly opposed to the practice, on the ground that there is always a degree of vital depression which forbids it. The latter is the position generally held by the army surgeons in India, who have the best opportunities for the study of this disease. When the insensibility continues the douche may be repeated and the bowels should be relieved by active cathartics or enemata. Where the breathing is very difficult and the bronchial tubes are clogged with mucus, the patient should be often turned upon the side and face. In cases of heat fever, treatment consists in the reduction of the temperature by the external application of cold, the use of sinapisms of enemata, and the administration of suitable salines and aperients, the diet being of the blandest and most nourishing nature. In the epileptiform convulsions that occur so frequently, the inhalation of chloroform or of ether may be very beneficial, but the use of these remedies requires skilled medical supervision, and their administration must be carefully watched. The sequelæ of sunstroke require to be treated upon general principles—removal to a cool climate, habits of temperance and abstinence, and the avoidance of undue exposure to heat, extreme exertion, or mental anxiety being the best means of mitigating their severity.

SUPERCAR'GO, an officer or person in a merchant ship whose business it is to manage the sales and superintend all the commercial concerns of the voyage.

SUPERFI'CIES, the Latin form of the word surface, sometimes bearing the sense of surface, and sometimes of area. The quantity of an area is called its superficial content, as distinguished from linear content or length, and solid content or bulk. See also SURFACE.

SUPER'FLUOUS INTERVALS, in music, are those which are greater than major, or than perfect. The term is now somewhat old-fashioned, and augmented is the recognized description of such intervals. See INTERVAL.

SUPERIOR, LAKE. See CANADA.

SUPERMA'JOR and **SUPERMI'NOR,** the names given by acousticians to certain Thirds found in the justly intoned scale with a natural or subminor Seventh: that is, when B flat bears the ratio to the C above it that 7 bears to 8, instead of (as in our usual justly intoned scale) the B flat being the minor Third above the dominant (G), and the number 7 being thereby banished from the musical ratios. When there is a subminor Seventh the Third between this B flat and the D above it has the ratio 7 : 9 instead of 4 : 5. The latter is the ordinary just major Third, the former is therefore called the supermajor Third. It has 435 cents, 100 cents going to the semitone of equal temperament. The superminor Third is found in the fourth octave of the harmonic chord, between B flat and D flat above it, the ratio being 14 : 17. The superminor Third has 336 cents, 100 cents going to the semitone of equal temperament. Ordinary just Thirds have only 386 cents (major) and 316 cents (minor) respectively; the corresponding Thirds of equal temperament, such as those of our pianoforte, &c., measuring 400 and 300 cents.

SUPERSATURA'TION. A liquid is said to be saturated with a solid substance when it has taken up as much as it will dissolve without depositing any of the solid. But if the liquid is warmed it usually dissolves more of the solid than when cold; and if the solution is able to be cooled and still to carry the excess of solid without depositing any of it, it is said to be supersaturated; for it holds when cool far more than it would hold if it were saturated in the ordinary way. Liquids are sometimes supersaturated with gas (as in the manufacture of soda-water, champagne, &c.) by means of pressure. A liquid at or near the boiling point is a supersaturated solution of its own vapour.

Supersaturated saline solutions possess remarkable properties. A supersaturated solution of sodic sulphate or Glauber's salt, when boiled and filtered, may be kept clear for a long time if no nuclei are allowed to gather. A cotton wool plug will exclude them quite effectually. Several other similar solutions will act in the same way. Even many solid bodies if boiled with the solution will not act as nuclei, nor will a drop of oil, if wholly immersed. But if the same oil be spread over the solution as a film, it acts as a powerful nucleus, and large crystals separate at its under surface and fall to the bottom of the solution until the latter is reduced to ordinary saturation point.

Supersaturated solutions of hydrated double salts carefully covered in clean vessels may be cooled down to the zero of Fahrenheit or below that without separation. They then yield unstable hydrates in tetrahedral crystals. On the temperature being raised to freezing point (32° Fahr.) the hydrates rapidly dissolve and the solution again becomes supersaturated. These changes may be repeated many times if nuclei are carefully excluded.

SUPERSEC'OND, an interval in music, only occurring in specially tuned instruments with a subminor Seventh. [See the article SUPERMAJOR.] Like the supermajor and superminor Thirds so the supersecond (or supermajor second) is formed from the subminor Seventh, and on such acoustical experimental instruments as Mr. Ellis's justly-tuned harmonical occurs between B flat and C, with the ratio 7 : 8, having 231 cents, 100 cents going to the ordinary semitone of equally tempered tuning. It is evident at once what a very wide interval it is, 231 : 200 as compared with the Second of our ordinary pianofortes (equal temperament).

SUPERSTI'TION may be defined as belief in anything, especially in anything abnormal or supernatural, without sufficient evidence. The term is from the Latin, and comes from *super*, over, and *sto*, I stand; the awestruck believer standing still, lost in fear, before the phenomenon which affects him. The Romans limited their word to excessive religious belief, but the modern usage gives it wide scope.

Popular superstitions rapidly diminish before the sun of knowledge, but their number is still great. Formerly the whole lives of the vulgar were passed in an atmosphere of dread. Nothing could be begun on a Friday, animals crossing one's path, or birds flying this or that way were fearful portents; dreams had prophetic meanings, the guttering of candles, the crackling of the fire, the spilling of salt, and hundreds of such trifles became matters of grave import. To sit down thirteen to dinner was almost an act of murder, as one of the company would infallibly die before the year was out; and to lay down the knife and fork crosswise in the plate heralded disaster. Even at this day testimony, unless in special cases, is not received in our courts of law except the witness kiss the New Testament, having taken it with the right hand—a remarkable survival of an ancient superstition. It will be found on inquiry

that the lower orders still have a firm belief in many most absurd superstitions, though they are shy of admitting it if they think they will be laughed at. It is not uncommon for a servant who has broken two pieces of crockery in succession, and who knows (as we all know) that her fate is unavoidable as to breaking a third, to select some cheap or cracked piece and wilfully dash it to atoms in order to save that which is more valuable from the chance of becoming the victim. To draw up a fire, these same maids will lay the poker crosswise on the top bar; the sacred emblem scaring away all evil influences and permitting the fire to fulfil its comfortable office.

Moon-superstitions form a large class. That the moon influences the weather is practically universally believed in the country districts: in a spell of bad weather the "change of the moon" is eagerly looked for to break the adverse fate. Then, too, if a pig is killed under a waning moon, the pork, it is well known, and Dr. Johnson says the belief was the same in his day, will waste in the boiling. So grave an authority as the excellent Elizabethan writer Tusser, in his "Five Hundreth Points of Good Husbandry," says, not ironically, but in all seriousness:—

> "Sow peasen and beans in the wane of the Moone,
> Who soweth them sooner he soweth too soone;
> That they with the Planet may rest and rise
> And flourish with bearing, most plentifulwise."

Untold evils will occur to any one who first sees the new moon through glass, unless the unfortunate person at once averts the omen by turning the money in his pocket. In fact, the latter is a good thing to do whenever the new moon is first seen. A new moon with horns turned well upwards "holds the water," but if the horns are not in that position, down comes the rain. A good sign of fine weather is to see "the old moon in the arms of the new one."

Another principal division relates to dress and personal habits. It is lucky to put on by accident and wear all day any article of clothing inside out, though no luck (save ill-luck) attends such a thing if done on purpose. This is the reason of William the Conqueror's victory at Hastings, when in his hurry (as is really historically true) he put on his chain-armour hind-side before, and refused to alter it, for said he, "It betokens that I am to be changed from a duke to a king." Cutting the nails is an important operation with the superstitious, and the many rules to be observed, if one would be safe, are too long to be given here. The superstition is of the hoarest antiquity, for in Hesiod's "Works and Days," our oldest book in western speech, save Homer, we find, "Cut not from the fi branched tree (the hand) with glittering iron, separating the dry from the quick, during the rich feast of the gods," exactly as our modern warning gives it, "Cut your nails on Sunday and you will have the devil with you all the week." Strict Mohammedans scrupulously bury hair cuttings and nail parings.

Marriage is fenced about with superstitions. If tl moon is full so is the bride's cup of happiness. Even more important than the moon's age is the day of the week.

> "Monday for wealth, Tuesday for health,
> Wednesday the best day of all;
> Thursday for crosses, Friday for losses,
> Saturday no luck at all."

Before going to church the bride must cry, and she must not look at herself in the glass when fully dressed, or mischief will ensue; entering church she must neither look back nor turn back, and coming home from church, as she nears her father's house, a plate of cake must be thrown from a window so as to break the plate and scatter the crumbs. This, however, is risky, for should the plate not break it is a terrible sign. Finally, when the bridesmaids unrobe their fair charge they must throw away all the pins; if a single one be left about her nothing will go right. In her travelling dress they must necessarily include—

> "Something old and something new,
> Something gold and something blue."

Gambling superstitions are among the few delusions of the kind that are really believed in by educated people. As a rule superstition and ignorance go together; but in this instance it is rather the alliance of superstition with a low moral than a low intellectual type. Few of those unfortunate people in whom greed, cruelty, and cunning have taken this specious form of semi-madness, this craving after the excitement of luck regardless of one's own merit or the losses of others, but have more faith in some utterly absurd "rules" than in the whole of the decalogue. To shuffle the cards overlong shuffles away the luck. To play with passion inevitably forfeits the luck. Stubbornness at play is ruin; fortune never forgives those who neglect her warnings. The cards never forgive; a revoke or a piece of careless play is revenged by them often for a whole evening. Such are the minor follies. More serious are the calculations. "In a game of chance, the oftener the same combination has occurred in succession the nearer we are to the *certainty* that it will not recur at the next cast. This is called the maturity of the chances." The truth is, as any one who has experimented with tossing pennies may testify, that the chance (if of that equal kind) is perfectly even. It makes no difference if we have had tail three times running, it is precisely as likely to come tail as head at the next throw. But the gambler's superstition of the maturity of the chances has ruined thousands of victims. Many distinguished men of science have tossed pennies (Buffon was the first, perhaps) to test this fact. In the thousands of cases recorded by Buffon, he often tossed head nine times running. Then, according to the gambler's rule, he would hardly ever toss head a tenth time. On the contrary he tossed head on about half such occasions, just as in cool sense we should expect. Suppose 1000 persons toss as long as heads continue. Manifestly about 500 only would have heads, and of these about half would toss head a second time. Of these 250, a third head would be tossed by 125; and about 62 would toss four heads running; 31 would probably reach five heads; 15 six heads, 7 seven heads, 3 or 4 eight heads, and at least one, in all probability, would toss nine heads running. The thing is the simplest in the world, but no real gambler believes it, even upon proof. The above calculation also shows the certainty that curious runs of luck will occur now and then, and also that ill-luck comes rather as an epidemic than as a run, sweeping away not its one unlucky victim, but about half (at an even-chance game) of the gamblers.

Not every superstition can be as easily shown to be fallacious. A shipbuilder determined to regain Friday as a sailing day. He began a ship on a Friday, launched her on a Friday, started loading her on a Friday, named her the *Friday*, and sent her off on a Friday. The ship was never more heard of, and the sailors' superstition was confirmed. Still more authentic is the annoying case that happened with Flamsteed, the first astronomer-royal. A poor woman who thought astronomy and astrology were the same thing came to ask his aid in finding a parcel of linen; Flamsteed, to destroy this pernicious superstition, gravely drew an astrological figure, and declared the parcel to lie in a certain ditch. To his horror the old woman returned radiant, having found the parcel where indicated.

The superstitions about the prophetic nature of dreams are shared by many imaginative persons even among the educated. There are many most extraordinary coincidences actually verified and on record, and the nature of the human mind is such as to let one such success outweigh a thousand failures. Very few dream-coincidences could

equal those of the lives of Viscountess Beaconsfield (Mrs. Disraeli) and George Eliot (Mrs. Cross) when thus stated:—The name of each lady was Marian Evans; each one became Mrs. Lewis; after the death of her first husband each married a man much younger than herself, and each lady died widely known by a name which was neither her maiden name nor that of either of her husbands (Mr. Disraeli was still a commoner at his wife's death), and the death of each was a matter of national interest. Compare these coincidences, familiar to every one, with those of dream-prophecies, and in most cases they will bear away the palm for exactness.

In fact, as soon as all people know how to reason, and habitually use that knowledge, they will not refuse to watch a pot lest they should delay the boiling, nor to count their fish lest their angling should have no more luck, nor to pass beneath a ladder, nor even—*mirabile dictu!*—to gaze fearlessly upon the new moon if she happens, when seen for the first time, to be at one's left. In higher things also superstition will no longer be able to claim them as her votaries.

SUPERTON'IC, in music, the note in the diatonic scale next above the tonic or key-note, and forming with it the interval of the second (a major tone), as A in the key of G major. The chords of the supertonic have great importance in modern music, because their root is the dominant of the dominant; and just as dominant harmonies control the tonic, when the piece is in the tonic, so do supertonic harmonies control the dominant in the modulation to the key of the dominant, which almost invariably occurs. Consequently the discords of the supertonic rank among the most powerful and valuable of the fundamental discords. See DISCORDS, FUNDAMENTAL.

SUP'PLEMENT OF AN ANGLE, in mathematics, that angle which, together with the original angle, will make up two right angles. Thus, 150° is the supplement of an angle of 30°, since it takes that addition (or supplement, whence the name) to increase from 30° to 180°, the latter being the angular measure of two right angles.

SUPPLICA'TIO, the name given to the classical ceremonies of general thanksgiving or humiliation. After a great victory had been gained a *supplicatio* would be decreed, of a length suitable to the importance of the occasion: all the temples were opened amid universal holiday-making, and the statues of the gods, arranged on handsomely covered couches, received the public prayers and thanksgivings. From the supplications of one or two days the republic in its last days passed to the absurdities of ten days (Pompey the Great, Mithradatic War), fifteen days (Cæsar, Belgic War), and even twenty days (Cæsar, conquest of Vercingetorix). The only one who ever received the honour of a supplicatio save for military prowess was Cicero, when, as consul, he suppressed the conspiracy of Catiline.

The same name was also given to solemn fasts of humiliation in times of distress and danger, when the statues of the gods were publicly prayed to that they might avert the evils threatening the state.

SUPPLY. See DEMAND AND SUPPLY.

SUPPLY, COMMITTEE OF, in parliamentary phraseology, is a committee of the whole House of Commons, to which are submitted the annual estimates of expenditure for the current year. On resolutions moved in committee of supply, and duly carried, are founded the bills which provide for the current expenditure. The resolutions are reported to the House, and adopted or rejected. The sums thus allowed by the House are afterwards raised by resolutions submitted to another committee of the whole House, that of Ways and Means. These are special functions of the House of Commons, which never permits the House of Lords to make any alterations or amendment in the bills passed for such purposes.

SUPPOS'ITORY, in medicine, is the name given to a solid mass which is introduced through the anus into the lower bowel for remedial purposes. Suppositories are rounded, usually elongated masses, containing one or more active ingredients combined with some substance that will dissolve or melt with the heat of the bowel. The British Pharmacopœia recognizes seven medicated suppositories, in four of which the medicine is mixed with white wax, cacao-butter, and benzoated lard—glycerine of starch, curd soap, and starch being used for the others. They are enumerated as follows:—(1) *S. acidi tannici*, of which the active ingredient is 3 grains of tannic acid; (2) *S. hydrargyri*, containing 5 grains of mercurial ointment; (3) *S. morphiæ*, containing ½ grain of hydrochlorate of morphia; and (4) *S. plumbi*, made to convey 3 grains of acetate of lead and 1 grain of opium. The suppositories made with glycerine of starch, curd soap, and starch are (1) *S. acidi carbolici cum sapone*, having 1 grain of carbolic acid; (2) *S. acidi tannici cum sapone*, containing 3 grains of tannic acid; and (3) *S. morphiæ cum sapone*, ½ grain of hydrochlorate of morphia. Other suppositories are used by medical practitioners, and many drugs can be employed in this way with advantage. A suppository may be used as an aperient, or to check excessive action of the bowel, to bring remedies into contact with a local disease, to influence adjacent organs, and to bring the system under the action of a drug by absorption.

SUPPURA'TION. See INFLAMMATION.

SU'PRALAPSA'RIANS. See SUBLAPSARIAN.

SUPREM'ACY is a term used to designate supreme ecclesiastical authority, and is either papal or regal. Papal supremacy was the authority exercised until nearly the middle of the sixteenth century by the Pope over the churches of England, Scotland, and Ireland, as branches and integral parts of the Western or Latin Church.

The papal supremacy was abolished by the legislatures of the three kingdoms in the sixteenth century. In order to secure acquiescence in that abolition, particularly on the part of persons holding offices in England and Ireland, an oath was required to be taken which was generally called the Oath of Supremacy, a designation calculated to mislead, as it was in fact an oath of *non*-supremacy; since, though in its second branch it negatived the supremacy of the Pope, it was silent as to any supremacy in the King. The form of the oath was established in England by 1 Will. & Mary, c. 8. Under this and many previous statutes all subjects were bound to take the oath of supremacy when tendered; but by the 31 Geo. III. c. 32, s. 18, no person after the 24th June, 1791, was liable to be summoned to take the oath of supremacy, or prosecuted for not obeying such summons; and Roman Catholics, upon taking the oath introduced by that Act, s. 1, in which the *civil* and *temporal* authority of the Pope are abjured, might hold office without taking the oath of supremacy. By 10 Geo. IV. c. 7, commonly called the Catholic Emancipation Act, Roman Catholics were restored in general to the full enjoyment of all civil rights, and persons taking the oath prescribed by that Act were relieved from all disabilities and penalties whatever. The Act of 21 & 22 Vict. c. 48 first prescribed one form of oath for the oaths of allegiance, supremacy, and abjuration. [See ABJURATION.] Now by the 29 & 30 Vict. c. 19, the uniform oath to be taken by members of both Houses of Parliament is as follows:—

"I, A B, do swear that I will be faithful and bear true allegiance to her Majesty Queen Victoria; and I do faithfully promise to maintain and support the succession to the crown, as the same stands limited and settled by virtue of the Act passed in the reign of King William the Third, intituled, 'An Act for the further Limitation of the Crown, and better securing the Rights and Liberties of the Subject,' and of the subsequent Acts of Union with Scotland and Ireland. So help me God.'

Henry VIII. was acknowledged as supreme head of the Church of England by the clergy in 1528. This supremacy was confirmed by Parliament in 1534, by the statute of 26 Henry VIII. c. 1.

SUPREM'ACY, ACTS OF. These Acts confer the headship of the Church of England upon the sovereign. The first and chief of them was passed in 1534 at the instance of Henry VIII., who upon the quarrel with Rome over the refusal of Clement VII. to deal straightforwardly with the question of the king's divorce from Catharine of Aragon (his brother's widow), broke altogether with the Pope, and when the latter, while himself refusing to conclude the case, annulled Cranmer's decision as to the validity of the king's marriage, assumed the title of "Supreme Head of the Church of England on Earth," confirmed upon him by this famous Act (26 Henry VIII., c. 1). Later in the year a second Act (26 Henry VIII., c. 13) was passed, supplementing the former.

In Mary's reign the ancient religion had been restored, and the authority of the Pope as head of the church again recognized; it was therefore necessary, as the first thing in Elizabeth's reign, to pass a new Act of Supremacy (1 Eliz., c. 1), once more establishing the reformed Church of England, with the queen at its head, and "restoring the ancient jurisdiction of the crown over the estate ecclesiastical and spiritual." The supremacy of the queen was to be acknowledged by all ministers and officials "as well in spiritual or ecclesiastical things or causes as temporal," and all persons upholding "the authority of any foreign prince or prelate" were to "forfeit their goods for the first offence, to incur the penalties of præmunire for the second, and to be executed as traitors for the third." Under this Act the supremacy of the crown has ever since existed.

SURA'JAH DOW'LAH, more properly *Suraj-ud-Dowlat*, Subahdar or Viceroy of Bengal, born in 1737, succeeded, at the age of nineteen, his granduncle, Aliverdi Khan. Adding a feeble understanding to a brutal disposition, he immediately after his accession picked a quarrel with the English in Bengal, and appeared in the June of 1756 with an overwhelming force before Calcutta. The circumstances under which the city was surrendered by the English, and the atrocity of the Black Hole of Calcutta, which was perpetrated with the connivance, though not exactly by the command of Surajah Dowlah, have been recorded in the article BLACK HOLE OF CALCUTTA. Surajah Dowlah returned in triumph to his capital, Moorshedabad; but when Clive had retaken Calcutta, and achieved other successes, the tyrant made a treaty of alliance with the English. He soon, however, broke it, and on the 23rd June, 1757, on the field of Plassy [see CLIVE, LORD], signal retribution was taken for the Black Hole atrocity. Surajah Dowlah fled when he saw his faithless coadjutor Meer Jaffier retreat as Clive advanced to the charge. Meer Jaffier became viceroy of Bengal, and Surajah Dowlah, afterwards seized while attempting to escape, was brought to Moorshedabad, and murdered in his cell by order of Meer Jaffier's son in 1757.

SURAT', a British district in Guzerat, Bombay, lying between 20° 15′ and 21° 28′ N. lat., and between 72° 38′ and 73° 30′ E. lon., with an area of 1669 square miles, and a population of 620,000. The district consists of a broad alluvial plain, stretching between the Dang Hills and the coast, from the Kim River on the north to the Damanganga on the south. The coast-line runs along the Arabian Sea, where it begins to narrow into the Gulf of Cambay. Small hillocks of drifted sand fringe the greater part of the shore, in some parts dry and barren, but in others watered by springs, inclosed by hedges, and covered with a thick growth of creepers and date-palms. Through the openings of the river mouths, however, the tide runs up behind the barrier of sandhills, and floods either permanently or temporarily a large area of salt-marshes. Beyond spreads a central alluvial belt of highly cultivated land, with a width of about 60 miles in the north, where the important river Tapti forms a deep and fertile delta; but as the coast-line trends towards the south, the hills at the same time draw nearer to the coast, and so restrict the alluvial country to a breadth of little more than 15 miles on the Daman border. The deep loam brought down by the Tapti gives a level aspect to the northern tract; but further south, a number of small and rapid rivers have cut themselves ravine-like beds, between which lie rougher uplands with a scantier soil and poorer vegetation. In the hollows, and often on the open plain, rich deposits of black cotton-soil overlie the alluvium. The eastern border of the district consists of less fruitful lands, cut up by small torrents, and interspersed with mounds of rising ground. Here the huts of an ill-fed and almost unsettled peasantry replace the rich villages of skilled cultivators in the central lowland. On the border this wild region passes gradually into the hills and forests of the Dangs, an unhealthy jungle which none but the black aboriginal tribes can visit save at special periods of the year. The hills themselves consist of trap in many varieties, from solid basalt to soft amygdaloid, and belong orographically to the great trappean plateau of Central and Western India. Here cultivation entirely disappears, and the whole country lies under wild brushwood. The chief rivers of Surat are the Tapti and the Kim, on the former of which stands the city of Surat. The Tapti gives rise to the largest alluvial lowland in the district; but its frequent floods till lately caused great loss of life and damage to property. It enjoys a reputation for sanctity in Western India second only to that of the Narbada. The district contains no natural lakes; but reservoirs cover a total area of 11,000 acres. With one exception, they consist of small ponds, formed by throwing horseshoe embankments across the natural lines of drainage.

Surat, in spite of the commercial importance of its chief town, still remains an essentially rural district. The cultivated area has largely increased of late years. Rice forms the staple crop; it is grown chiefly on the black or red soil in the neighbourhood of ponds. Millet (*joàr*) holds the second place. It is largely grown in the northern part of the district. Cotton is chiefly grown in the valley of the Tapti. It can only be raised in rotation with other crops. *Kodra* and *nàgli* form the food of the poorest classes. Sugar-cane flourishes better in Surat than in any other district of Guzerat, and constitutes the favourite crop in garden land. Molasses manufactured by the cultivators forms a large item of export to Northern Guzerat and Kathiewar. *Bàjra* and tobacco occupy small areas. The two usual harvests, *kharìf* and *rabi*, prevail in Surat as in the rest of Guzerat. The most striking feature in the agriculture of the district is the difference between the tillage of the *ujli*, or fair races, and that of the *kàla*, or dark aboriginal cultivators. The dark races use only the rudest processes; grow little save the coarser kinds of grain, seldom attempting to raise wheat or millet; and have no tools for weeding or cleaning the fields. After sowing their crops they leave the land, and only return some months later for the harvest. As soon as they have gathered in their crops, they barter the surplus grain for liquor. The fair cultivators, on the other hand, who own the rich alluvial soil of the lowlands, are among the most industrious and intelligent in Western India. Except at the beginning of the season, and during harvest, the small proprietors are generally able, with the help of their families alone, to till their fields without hired labour. Among the sugar-cane villages in the south, however, large numbers of labourers find employment. Small holdings form the rule in Surat; but as a large number of them consist of garden land, they support the proprietors in comparative comfort. The cultivators also earn considerable sums by carting timber and grain from the inland

villages to the railway and the sea-coast. Almost all the dark races, from their indolence and love of drink, are heavily in debt; but the fair races, though often under obligations to the money-lenders, are usually in comfortable circumstances. Government has instituted a scheme for reclaiming the waste lands overflowed by the tide on terms highly remunerative to the public; and a large area has been taken on lease for this purpose. These measures have on the whole met with excellent success. Irrigation is mainly carried on from ponds and reservoirs.

Among manufactures the spinning and weaving of cotton holds the first place, employing almost the entire female population, both rural and urban, except among the aboriginal tribes. Surat city contains two steam factories for spinning and weaving. Silk brocade and embroidery are also largely manufactured by handlooms. The Bombay, Baroda, and Central India Railway runs through the whole district from north to south, a distance of 71 miles, with fifteen stations. A magnificent iron girder bridge crosses the Tapti at Surat city.

The climate of Surat varies greatly with the distance from the sea. In the neighbourhood of the coast, under the influence of the sea-breeze, an equable temperature prevails; but from 8 to 10 miles inland the breeze ceases to blow. The coast also possesses a much lighter rainfall than the interior, the annual average ranging from 30 inches in Olpad to 72 inches in Chikhli. The average at Surat city amounts to 46 inches. The common endemic diseases include fever, ague, dysentery, and diarrhœa.

SURAT, a city and the administrative headquarters of the above district, and former seat of a presidency under the East India Company, is situated on the southern bank of the river Tapti, distant from the sea 14 miles by water, 10 miles by land. It was once the chief commercial city of India, and is still an important mercantile town, though the greater portion of its export and import trade has long since centred in Bombay.

Surat lies on a bend of the Tapti, where the river suddenly sweeps westward towards its mouth. In the centre of its river front rises the castle, a mass of irregular fortifications, flanked at each corner by large round towers, and presenting a picturesque appearance when viewed from the water. Planned and built in 1540 by Khudawand Khan, a Turkish soldier in the service of the Guzerat kings, it remained a military fortress under the Mogul and the British rule till 1862, when the troops were withdrawn and the buildings utilized as public offices. With the castle as its centre, the city stretches in the arc of a circle for about a mile and a quarter along the river bank. Southward, the public park with its tall trees hides the houses in its rear; while low meadow lands elsewhere fringe the bank, from which the opposite ground rises slightly northward on the right shore, toward the ancient town of Rander, now almost a suburb of Surat. Two lines of fortification, the inner and the outer, once incl ed Surat; and though the interior wall has long since all but disappeared, the moat which marks its former course still preserves distinct the city and the suburbs. Within the city proper the space is, on the whole, thickly peopled; and the narrow but clean and well-watered streets wind between rows of handsome houses, the residences of high-caste Hindus and wealthy Parsis. The suburbs, on the other hand, lie scattered among wide open spaces, once villa gardens, but now cultivated only as fields. The unmetalled lanes, hollowed many feet deep, form water-courses in the rainy season, and stand thick in dust during the fine weather. The dwellings consist of huts of low caste-Hindus or weavers' cottages. West of the city the military cantonment lies along the river-bank, with its open parade-ground stretching down to the water's edge.

During the eighteenth century Surat probably ranked as the most populous city of India. With the transfer of its trade to Bombay, the numbers rapidly fell off. In 1811 an official report returned the population at 250,000 persons, and in 1816 at 124,406. In 1847, when the fortunes of Surat reached their lowest ebb, the number of inhabitants amounted to only 80,000. Thenceforward the city began to retrieve its position, and the population is now 115,000. The Parsis and high-caste Hindus form the wealthy classes; the Mussulmans are in depressed circumstances, except the Borahs, many of whom are prosperous traders. Fondness for pleasure and ostentation characterize all classes and creeds in Surat alike. Caste feasts and processions are more common and more costly than elsewhere. Fairs, held a few miles away in the country, attract large crowds of gaily dressed men and children in bright bullock-carts. The Parsis join largely in these entertainments, besides holding their own old-fashioned feasts in their public hall. The Borahs are famous for their hospitality and good living. The extravagant habits engendered by former commercial prosperity have survived the wealth on which they were founded.

In 1837 two calamities occurred in close succession which destroyed the greater part of the city, and reduced almost all its inhabitants to a state of poverty. For three days in the month of April a fire raged through the very heart of Surat, laying 9373 houses in ruins, and extending over nearly 10 miles of thoroughfare, both in the city and the suburbs. No estimate can be given of the total loss to property, but the houses alone represented an approximate value of £450,000. Towards the close of the rainy season in the same year the Tapti rose to the greatest height ever known, flooded almost the whole city, and covered the surrounding country for miles like a sea, entailing a further loss of about £27,000. This second calamity left the people almost helpless. Already, after the fire, many of the most intelligent merchants, both Hindu and Parsi, no longer bound to home by the ties of an establishment, had deserted Surat for Bombay. In 1838 it remained "but the shadow of what it had been, two-thirds to three-fourths of the city having been annihilated." From 1840 onward, however, affairs began to change for the better. Trade improved and increased steadily, till in 1858 its position as the centre of railway operations in Guzerat brought a new influx of wealth and importance. The high prices which ruled during the American War again made Surat a wealthy city. The financial disasters of 1865–66 in Bombay somewhat affected all Western India, but Surat nevertheless preserved the greater part of its wealth. At the present day the well-kept streets, public buildings, and large private expenditure stamp the city with an unmistakable air of steady order and prosperity.

The principal articles of export are agricultural produce and cotton. Since the opening of the railway, however, a great and growing land traffic has sprung up, which has done much to revive the prosperity of the city. The port of Surat is at Suwali, 12 miles west of the city. The railway station of the Bombay, Baroda, and Central India Railway is outside the city, surrounded by a rising suburb. The organization of trade-guilds is highly developed in Surat. The chief of these guilds, composed of the leading bankers and merchants, is called the *mahájan* or banker-guild. Its funds, derived from fees on cotton and on bills of exchange, are spent partly on the animal hospitals and partly on the temples of the Vallabha Acharya sect. The title and office of Nagarseth, or chief merchant of the city, hereditary in a Srawak or Jain family, has for long been little more than a name. Though including men of different castes and races, each class of craftsmen has its trade-guild or *panchayat*, with a headman or referee in petty trade disputes. They have also a common purse, spending their funds partly in charity and partly in entertainments. A favourite device for raising money is for the men of the craft or trade to agree, on a certain day, to shut all their

shops but one. The right to keep open this one shop is then put up to auction, and the amount bid is credited to the guild fund.

The English church stands upon the river bank between the castle and the custom-house, and has seats for about 100 persons. The Portuguese or Roman Catholic chapel occupies a site near the old Dutch factory. The Mussulmans have several large mosques, of which four are handsome buildings. The Nav Sayyid Sahib's mosque stands on the bank of the Gopi Lake, an old dry tank, once reckoned among the finest works in Guzerat. The Parsis have two chief fire-temples for their two subdivisions. The principal Hindu shrines perished in the fire of 1837, but have since been rebuilt by pious inhabitants. Gosavi Maharaja's temple, built in 1695, was renewed after the fire at a cost of £10,000. Two shrines of Hanuman, the monkey-god, are much respected by the people. The tombs of early European residents form some of the most interesting objects in Surat. Two hospitals provide for the indigent poor; and there is a similar institution for sick or worn-out animals. The clock-tower on the Delhi road, 80 feet in height, was erected in 1871 at the expense of Khan Bahadur Barjorji Merwanji Frazer. The high school provides accommodation for 500 boys.

The municipality has opened a number of excellent roads, well lighted, paved, and watered. It has also constructed works for the protection of the city from floods, and for lessening the risk of fire. Systems of drainage, conservancy, and public markets have also been carried out. No city in the presidency, except Bombay, owes so much to its municipality as Surat.

History.—Surat was one of the earliest portions of India brought into close relations with European countries, and its history merges almost entirely into that of its capital, long the greatest maritime city of the peninsula. As early as 1514 the Portuguese traveller Barbosa describes Surat as "a very important seaport, frequented by many ships from Malabar and all other ports." Two years before the Portuguese had burnt the town, an outrage which they repeated in 1530 and 1531. Thereupon the Ahmedabad king gave orders for building a stronger fort, completed about 1546. In 1572 Surat fell into the hands of the Mirzas, then in rebellion against the Emperor Akbar. Early in the succeeding year Akbar arrived in person before the town, which he captured after a vigorous siege. For 160 years the city and district remained under the administration of officers appointed by the Mogul court. During the reigns of Akbar, Jahangir, and Shah Jahan, Surat enjoyed unbroken peace, and rose to be one of the first mercantile cities of India. Since 1573 the Portuguese had remained undisputed masters of the Surat seas. But in 1608 an English ship arrived at the mouth of the Tapti, bringing letters from James I. to the Emperor Jahangir. Mukarab Khan, the Mogul governor, allowed the captain to bring his merchandise into the town. Next year a second English ship arrived off Guzerat, but was wrecked on the Surat coast. The Portuguese endeavoured to prevent the shipwrecked crew from settling in the town, and they accordingly went up to Agra with their captain. In 1611 a small fleet of three English ships arrived in the Tapti; but as the Portuguese occupied the coast and entrance, the English admiral, Sir H. Middleton, was compelled to anchor outside. Small skirmishes took place between the rival traders, until in the end the English withdrew. In 1612, however, the governor of Guzerat concluded a treaty by which the English were permitted to trade at Surat, Cambay, Ahmedabad, and Gogo. After a fierce fight with the Portuguese, the English made good their position, established a factory, and shortly after obtained a charter from the emperor. Surat thus became the seat of a presidency under the East India Company. The company's ships usually anchored in a roadstead north of the mouth of the Tapti, called in old books "Swally" or "Swally Road," but correctly Suwali. Continued intrigues between the Portuguese and the Moguls made the position of the English traders long uncertain, till Sir Thomas Roe arrived in 1615, and went on to Ajmere, where Jahangir then held his court. After three years' residence there Roe returned to the coast in 1618, bringing important privileges for the English. Meanwhile the Dutch had also made a settlement in Surat, and obtained leave to establish a factory. Early travellers describe the city as populous and wealthy, with handsome houses and a great trade. The fifty years between the establishment of the English and Dutch and the accession of Aurungzebe, formed a time of great and increasing prosperity for Surat. With the access of wealth the town improved greatly in appearance. Caravans came and went to Golconda, to Agra, to Delhi, and to Lahore. Ships arrived from the Konkan and Malabar coast; while from the outer world, besides the flourishing European trade, merchants came from Arabia, the Persian Gulf, Ceylon, and Acheen in Sumatra. Silk and cotton cloth formed the chief articles of export. The Dutch in particular made Surat their principal factory in India, while the French also had a small settlement. Under Aurungzebe the district suffered from frequent Marhatta raids, which, however, did little to impair its mercantile position. The silting up of the head of the Cambay Gulf, the disturbed state of Northern Guzerat, and the destruction of Diu by the Maskat Arabs in 1670 combined to centre the trade of the province upon Surat. Its position as "the Gate of Mecca" was further increased in importance by the religious zeal of Aurungzebe. But the rise of the predatory Marhatta power put a temporary check to its prosperity. The first considerable Marhatta raid took place in 1664, when Sivaji the Great suddenly appeared before Surat, and pillaged the city unopposed for three days. He collected in that short time a booty estimated at £1,000,000 sterling. Encouraged by this success the Marhatta leader returned in the year 1669, and once more plundered the town. Thenceforward for several years a Marhatta raid was almost an annual certainty. The Europeans usually retired to their factories on these occasions, and endeavoured, by conciliating the Marhattas, to save their own interests. Nevertheless, the city probably reached its highest pitch of wealth during this troublous period at the end of the seventeenth century. It contained a population estimated at 200,000 persons, and its buildings, especially two handsome mosques, were not unworthy of its commercial greatness. In 1695 it is described as "the prime mart of India—all nations of the world trading there; no ship trading in the Indian Ocean but what puts into Surat to buy, sell, or load." But the importance of Surat to the English East India Company declined considerably during the latter part of Aurungzebe's reign, partly owing to the growing value of Bombay, and partly to the disorders in the city itself. In 1678 the settlement was reduced to an agency, though three years later it once more became a presidency. In 1684 orders were received to transfer the chief seat of the company's trade to Bombay, a transfer actually effected in 1687. During the greater part of this period the Dutch were the most successful traders in Surat. From the death of Aurungzebe in 1707 the authority of the Delhi court gradually declined, and the Marhattas established themselves in power up to the very walls of Surat. The governors, nominally appointed by the Moguls, employed themselves chiefly in fighting with the Hindu intruders for the country just beyond the gates. At length, in 1733, Teg Bakht Khan, governor of the city, made himself entirely independent; and for twenty-seven years Surat remained under a native dynasty. For the first thirteen years of this period Teg Bakht Khan maintained an unbroken control over the city; but after his death, in 1746, a time of complete anarchy intervened.

The English and Dutch took an active part in the struggles for the succession, sometimes in concert, and sometimes as partisans of the rival competitors. In 1759 internal faction had rendered trade so insecure that the authorities at Bombay determined to make an attack upon Surat, with the sanction of the Marhattas, now practically masters of Western India. After a slight resistance the governor capitulated, and the English became supreme in Surat. For forty-one years the government of the new dependency was practically carried on by the conquerors, but the governors or Nawabs still retained a show of independence until 1800. The earlier years of the English rule formed again a flourishing period for Surat, when the city increased in size, owing partly to the security of British protection and partly to the sudden development of a great export trade in raw cotton with China. The population of the city was estimated at 800,000 persons; and though this figure is doubtless excessive, Surat was probably the most populous town in all India. Towards the close of the century, however, the general disorder of all Central and Southern India, and the repeated wars in Europe, combined to weaken its prosperity. Two local events, the storm of 1782 and the famine of 1790, also contributed to drive away trade, the greater part of which now centred itself in Bombay. In 1799 the last nominally independent Nawab died, and an arrangement was effected with his brother, by which the government became wholly vested in the British, the new Nawab retaining only the title and a considerable pension. The political management of Surat devolved upon an officer who bore at first the title of lieutenant-governor, since altered (after certain fluctuations) to that of agent to the governor of Bombay. The arrangements of 1800 put the English in possession of Surat and Rander; subsequent cessions under the treaties of Bassein (1802) and Poona (1817), together with the lapse of the Mundvi State in 1839, brought the district into its present shape. The title of Nawab became extinct in 1842. Since the introduction of British rule the district has remained free from external attacks and from internal anarchy, the only considerable breach of the public peace having been occasioned by the Mussulman disturbance in 1810. During the mutiny of 1857 Surat enjoyed unbroken tranquillity, due in great measure to the steadfast loyalty of its leading Mohammedan families.

SUR'COAT (Fr. *sur*, over; and Eng. *coat*), a garment usually made of silk, sometimes of velvet, which formed part of the knightly equipment of mediæval times, and derived its name from being worn over the body armour or coat of mail to protect it from the wet. It was frequently very richly embroidered, and adorned with precious stones.

SURD (Lat. *surdus*, dull, silent), in algebra and arithmetic, a magnitude which cannot be expressed by rational numbers. Thus it is not possible to express exactly in the ordinary notation the square root of 2, the cube root of 3, &c., and hence we employ the signs $\sqrt{2}$, $\sqrt[3]{3}$. Such quantities are also designated irrational or incommensurable.

SURDS AND SO'NANTS are the two great divisions of consonants. All vowels are sonant, and several consonants are partly so. The surd consonants give no audible utterance, but merely affect the speech by stopping sound in various ways; whereas the sonants, even while the closure lasts, permit the existence of sound, a stream of air sufficient to support a brief period of vibration being forced up from the lungs into the closed cavity formed by the pharynx and mouth together.

Thus for the surd mutes *k*, *t*, *p* (respectively palatal, dental, and labial sounds) we have the corresponding sonants *g*, *d*, *b*; and for the surd spirants *th*, *f*, we have the corresponding sonants *dh*, *v*; while for the surd sibilants *sh*, *s*, we have the sonants *zh*, *z*. (The nasals *ng*, *n*, *m*, and the semi-vowels *y*, *r* and *l*, *w*, are necessary to complete the tale of consonants.)

SURETY. A surety is one who undertakes to be answerable for the acts or omissions of another, who is called his principal. Such undertaking must be in writing, and it may either be by bond or by simple writing. A contract is not binding unless made upon some sufficient consideration; but in the case of a bond this consideration is inferred from the circumstances of deliberation incident to its execution as a deed. The instrument by which the surety becomes bound, when it has reference to civil matters, is generally called a guarantee, and ordinarily consists of an undertaking to become answerable for the payment of goods furnished to the principal, or for his integrity, skill, attention, and other like matters. It was at one time necessary that the consideration should be expressed on the face of the guarantee, but that is now no longer needful.

If a person gives a security by way of indemnity for another, and pays the money, this money may be recovered in an action against the principal. But in no case is the surety entitled to more than an indemnity from his principal.

If more persons than one become sureties for the same principal, they are called co-sureties. If one of them has paid the whole of the debt due from the principal, he may recover from his co-sureties the amounts for which they were respectively liable.

In Scotland, in *civil* matters, surety is known as *caution*, and in *criminal* cases as *bail*.

SURETY OF THE PEACE is the acknowledging of a recognisance or bond to the king, taken by a competent judge of record for keeping the peace. [See RECOGNISANCE.] Such recognisance may be obtained by any party from another on application to a magistrate, by stating on oath that he has just cause to fear that such other "will burn his house, or do him a corporal hurt, as by killing or beating him, or that he will procure others to do him such mischief." The fear must be of a present or future danger. Upon the neglect or refusal of the party so summoned to enter into the recognisances demanded, he may be committed to prison by the magistrate for a specified period.

The term recognisance is unknown in Scotland. *Caution to keep the peace* forms part of a criminal sentence, and a private party can obtain caution on swearing bodily fear at the hands of another person, under the form of what is termed "Lawburrows." He is compelled to find caution under a certain penalty, or suffer imprisonment; but he must be supported while in prison by the accusing party.

SURFACE. It is not so easy as at first sight it may appear to define this term, familiar as it is to every one. If we regard a cube of marble, and we speak of its upper surface, it is probable that to an unlearned man will be conveyed the idea of an infinitely thin slab of marble lying at the top of the cube. But a little reflection will show that on the same ground this surface might be as well imagined as an infinitely thin stratum of air touching the marble. Therefore it is manifest that in truth the surface is neither part of the marble nor part of the air, but is that which separates the two. A surface may be regarded as made up of lines in the geometrical sense, and geometrical lines have no thickness; or in exactly opposite words, but equally true, we may say that a surface is common to the marble and the air, and itself takes up no room whatever. It is a purely imaginary conception of the geometrician, and yet it is accurately true, as it is readily conceivable.

From this idea of a surface it is quite easy to derive the true geometrical idea of a line, for we have not to consider a line as a string made indefinitely thin, but rather as something which separates a surface into two parts, that

itself is of no thickness, merely being the division between them, or (which is equally true) their point of contact. Just as a surface is an ideal division between objects in close contact, so is a line an ideal division between adjacent parts of a surface. Similarly a point marks the division of a line; it is absolutely of no size whatever, it merely marks where one part of a line leaves off and another begins; and it is by no means to be arrived at by the paring down of a visible dot to invisibility. These excellent distinctions are marked with his accustomed clearness by Professor Clifford in his "Common-sense of the Exact Sciences." Of course we represent lines by black strokes and points by black dots, but these are merely visible symbols to assist our reasoning on the true lines and points which they indicate.

SURFACE OF THE EARTH. If the stratified and unstratified rocks which compose the skeleton of the earth were laid bare to our view, the aspect of the globe would be far more rugged than it is now. The soil, gravel, clay, peat, and other substances, which by their accumulation mask the features of the interior rocks, constitute a peculiar class of geological phenomena.

Soil is often supposed to be merely the disintegrated parts of the subjacent rocks; and this is sometimes really the case. But the soils which cover clays, limestones, and sandstones are seldom of this simple origin. The basis of these soils may be generally derived from the subjacent strata, but they usually contain foreign ingredients. We may often understand the cause of these admixtures by considering the effect of rains and currents of water on the sloping surface of the earth. These effects arrive at a maximum in particular vales and plains, into which many streams enter after flowing over strata of different kinds. In such vales the soil is in fact a mixture of calcareous, argillaceous, and arenaceous parts. To watery agency we may also ascribe many even extensive accumulations of gravel and sand which lie along the sides of valleys and in hollows of hills, or on the slopes of mountains. The beds of old lakes, often consisting of layers of shelly marl, with bones of existing or extinct quadrupeds, and the surfaces of silt which lie along the present and ancient estuaries of rivers, and often conceal buried forests and subterranean peat, present no difficulty as to their origin; for the processes by which peat grows and trees are buried, and marshy land is saved from the sea, and lakes are filled up, are at this day in action.

SURGEON, a fish. See ACANTHURUS.

SURGEONS, COLLEGE OF. The College of Surgeons of England had its origin in the Company of Barber Surgeons, which was incorporated by royal charter in the first year of Edward IV. The connection between the practice of barbers and that of surgeons began with the custom of employing the former to assist in the application of ointments, in blood-letting, in the use of medical baths, and in other healing operations, which from the tenth to the twelfth century were chiefly performed by the monks; but in 1163, the Council of Tours having prohibited the clergy from performing any operation that required bloodshed, the practice of surgery fell into the hands of the barbers. Their shop-sign was a blood-stained linen cloth wound about a pole; and the barber's pole, which may still be seen at old-fashioned shop-doors, is painted white and red, with spiral stripes, in imitation of the ancient token. By the charter of Edward IV. the barbers practising surgery in London, who had before associated themselves in a company, were legally incorporated as the Company of the Barbers in London. Their authority extended to the right of examining all instruments and remedies employed, and of bringing actions against persons who practised illegally and ignorantly; and none were allowed to practise who had not been previously admitted and judged competent by the masters of the company.

In spite of this charter many persons practised surgery independently of the company, and at length associated themselves as members of a separate body, and called themselves the Surgeons of London. In the third year of Henry VIII. it was enacted "that no person within the city of London, or within 7 miles of the same, should take upon him to exercise or occupy as a physician or surgeon, except he be first examined, approved, and admitted by the Bishop of London or by the Dean of St. Paul's for the time being, calling to him four doctors of physic, and for surgery other expert persons in that faculty." All who under this Act obtained license to practise were of course equally qualified, whether members of the Company of Barbers or not; and in the thirty-second year of Henry VIII. the members of the latter company, and those who had incorporated themselves as the Company of Surgeons, were united in one society, by the name of Masters or Governors of the Mystery and Commonalty of Barbers and Surgeons of London.

In the eighteenth year of George II. an Act was passed by which the union of the barbers and surgeons was dissolved, and the surgeons were constituted a separate company; and in the fortieth year of George III. (1800) a charter was granted by which it was confirmed in all the privileges which had been conferred upon it by the Act of George II. By this charter the title of the company was altered to that of the Royal College of Surgeons in London, and it was governed by a council or court of assistants, consisting of twenty-one members, of whom ten composed the court of examiners.

A new charter was granted in the seventh year of Victoria, by which it is declared, that the name of the college shall henceforth be the Royal College of Surgeons of England; and that a portion of the members of the said college shall be fellows thereof, by the name of the Fellows of the Royal College of Surgeons of England. Various special provisions as to the eligibility of fellows are stated. There are to be ten examiners of surgeons for the college elected by the council, either from their own body, or from the other fellows of the college, or from both of them; who are to hold their office during the pleasure of the council. The charter contains other regulations, and confirms the powers of the college and the council, except so far as they are altered by it. "The Bye-Laws and Ordinances of the Royal College of Surgeons of England" contain the regulations as to the candidates for the fellowship, for the examination of candidates for the fellowship, admission of fellows, and election of members of council. By section 1, it is required that every candidate for the fellowship, among other certificates, shall produce a statement satisfactory to the court of examiners, that he has attained a competent knowledge of the Greek, Latin, and French languages, and of the elements of mathematics. The subjects of examination for the fellowships are anatomy and physiology on the first day, and pathology and therapeutics and surgery on the second day. In the anatomical examination the candidate must also perform dissections and operations on the dead body in the presence of the examiners.

By an addition to the charter, granted in 1852, the council was empowered to issue certificates for the practice of midwifery, and subject to certain regulations, to appoint members of fifteen years' standing to the fellowship without examination. By the Dentists' Act, passed in 1878, the system of legal registration was extended to this class of practitioners, whose examination is referred to the Royal College of Surgeons.

The hall belonging to the College of Surgeons is situated in Lincoln's Inn Fields, London, and contains the finest museum of its kind in the United Kingdom. The splendid Hunterian collection [see HUNTER, JOHN], which was purchased by the government for £15,000 and presented to

the college, formed the basis of this museum, and numerous additions have been made to it at various times. It now contains upwards of 41,000 specimens, and there is a library of 31,000 volumes.

The increasing number of students presenting themselves at the Royal Colleges of Physicians and Surgeons had long exceeded the accommodation at the disposal of those learned bodies, and the pressure had become so great that in 1887 an Examination Hall was erected to serve for both colleges simultaneously. To do this required no straining of professional etiquette, for since 1884 the examinations at both colleges have been compulsory, and every medical student aiming at honours in the profession has been required to pass the necessary tests at both establishments. The uniting of the places of examination was therefore convenient.

The Examination Hall is a building of considerable importance, immediately west of Waterloo Bridge, between Savoy Street and Savoy Hill, the main front abutting on the Thames Embankment gardens, and commanding an extensive view. The Hall has accommodation for the examination of 600 students at one time.

SURGERY. See MEDICINE.

SU'RICATE (*Suricata zenick*) is a carnivorous mammal belonging to the civet family (Viverridæ), a native of South Africa. It stands about 6 inches high, and is about a foot in length exclusive of the tail, which measures 6 or 8 inches. The body is grayish-brown in colour with darker bands across the back; the ears and the tip of the tail are black. The legs are moderately long, and the feet have four toes provided with very long curved claws. The head is rounded, terminating in a long pointed snout, and the ears are short. The suricate is nocturnal in its habits, and lives in burrows. It is very docile and intelligent, and is sometimes domesticated to kill vermin.

SURINAM', the name sometimes given to Dutch Guiana, the central colony of Guiana, in South America (lying between British and French Guiana), from its principal river. Owing to the difficulty of obtaining labour, and the decline in the value of sugar, one of the chief products, the colony is not in a flourishing condition. The gold, of which about £100,000 is annually exported, attracts such labour as there is from the cultivation of the land. The chief town is Paramaribo.

SURINAM' TOAD (*Pipa americana*) is a singular batrachian belonging to the family Pipidæ and section Aglossa. The Surinam toad is remarkable for the development of the young in pouches on the back of the female. It is from 6 to 8 inches long and 4 or 5 broad. It has a flat toad-like body, with a short, broad, triangular head, large hind limbs with five-toed webbed feet, and small fore limbs, which have four slender toes unconnected by webs, and divided at the extremities into little projections. The skin is of a dirty brown colour, thickly studded with reddish tubercles. There is no tongue nor teeth on the jaws or palate, and the eyes are very small. The development of the young is said to take place in the following manner:—The eggs are deposited by the female in the ordinary way, probably under water, and are placed by the male on the soft skin of her back, and impregnated, forming by their pressure little pits, over which the skin closes. In a short time the back of the female swells, the pits deepen, and the eggs are hatched within them. The young animals pass through their tadpole stage in this singular nursery, and in two or three months they jump fully developed out of the now open cavities; the female then returns to the water to change the skin of her back. The Surinam toad is a native of Surinam and other parts of tropical South America. It inhabits swamps and ditches, and is often found in corners of houses. Notwithstanding its repulsive appearance, it is used as food by the natives in some parts of South America.

SURMUL'LET or **RED MULLET** (Mullus) is a genus of fishes belonging to the order ACANTHOPTERYGII and family Mullidæ, which is nearly allied to the perches (Percidæ). The surmullets have a thick, oblong, slightly compressed body covered with large thin scales. The two dorsal fins are widely separated from one another, the first with feeble spines; the pectoral fins are short, and the ventrals have one spine and five rays. There are four branchiostegal rays. There are a pair of long movable barbels on the throat suspended from the hyoid apparatus, and folded up against the lower jaw when not in use. The profile of the head is a convex curve, approaching to a vertical line. The teeth are very feeble, and altogether absent from the upper jaw. The genus Mullus is generally considered to contain two species, *Mullus barbatus* and *Mullus surmuletus*, both abundant in the Mediterranean, and occurring on British coasts; but according to Dr. Günther, the latter is probably the female of *Mullus barbatus*. The Striped Surmullet or Striped Red Mullet (*Mullus surmuletus*) is the more common of the two on British coasts, occurring often in abundance in the English Channel. It is of a bright red or vermilion colour on the back and flanks, with three or four yellowish lines disposed longitudinally on the lower parts of the sides. When mature it is from 12 to 14 inches in length. In British seas it weighs generally about 2 lbs., but in the Mediterranean a weight of 5 or 6 lbs. is sometimes attained. It approaches the shore in summer, and is then often caught in mackerel nets; the more usual way of taking it is by means of the trawl-net. It feeds on small crustaceans and molluscs. The changeful hues of this fish are of the most beautiful kind, especially when dying. Tints of the brightest scarlet pass suddenly into a greenish-red, while both lay their ever-varying shades alongside of streaks of pale ashy gray. This fish was esteemed a great delicacy by the Romans, and large sums were paid for it alive or dead. When taken alive it was put on the table in water that the guests at the banquet might witness the beauty of its hues when dying. The flesh was served up with a sauce made from the liver of the fish ground down and mixed in wine. One case is on record in which 30,000 sesterces (£243 10*s.*) were paid for one fish. This fish is still regarded as a great luxury, the flesh being white, firm, and very free from fat. Our fishermen scale the fish immediately after capture, so as to prevent the brilliant red colour from fading.

The Plain Red Mullet (*Mullus barbatus*) is of a duller colour, varying between red and olive-yellow. It is abundant in the Mediterranean, but is very rare in British seas, being only occasionally met with on the coasts of Berwickshire and Cornwall.

There are about forty species of Mullidæ belonging to nearly allied genera, chiefly from tropical seas; some of them enter brackish water and make their way up rivers.

SUR'NAMES. In the outset men were contented with one name, Adam, Eve, Cain, Abel, and in small societies this answered well. Each name had a definite meaning, as *red, life, possession, vapour*, in the cases above-named. But so soon as societies became more crowded it was not uncommon for two persons to bear the same name. Even in Homer we have Aias (Ajax), son of Telamon, and Aias, son of Oileus, while in the much later enumeration of the apostles we have to distinguish between James the son of Zebedee and James the son of Alphæus; between Simon Peter and Simon the Zealot, and between Judas the brother of James and Judas Iscariot, three pairs of names out of twelve persons. Of these six we observe that three have surnames of the patronymic class ("son of Zebedee," &c.), one has a true second name, one a nickname, and one a local name, so that between them they give specimens of most of the great varieties.

Evidently the easiest way of distinguishing a man from others of the same name is to add the name of his father; David the son of Jesse is well marked out from all other Davids. The Greeks always favoured this style of appellation, as in the well-known form Sokrates of Sophroniskos (son), &c., or the Homeric method, adjectival in form, Agamemnon the Atreid (Atreidês, *i.e.* son of Atreus). In Russia to this day persons are always addressed by the two names, Alexander Alexandrovich (Alexander, son of Alexander), being thus distinguished from Alexander Nicolaievich (Alexander, son of Nicolas); Marfa Dmitrievna (daughter of Demetrius), from Marfa Andreevna (daughter of Andrew), &c. Even between husband and wife the bare name is rarely used by Russians. Surnames are possessed by all Russians, but they are used with far less frequency than the primitive form just mentioned; the older form, in fact, has retained its ground. Similarly, among the ancient Romans a man was known as Marcus or as Marcus Tullius (*i.e.* of the Tullian gens or clan); only in comparatively few formal cases was his family name, as Cicero, used. The form *Tullius* means "descendant of Tullus," *Tulli-us*, where the *us* is the Greek *uios* (son), and *Tulli* is a genitivo. So with all the other gentile names, *Cæcili-us, Semproni-us*, &c., from legendary ancestors, Cæcilus, Sempronus, &c. How many of us think of the poets Maro or Naso or the African? We hardly know Virgil, Ovid, and Terence by those names.

But the use of the father's name in a country of very few names still leaves identification indistinct, and the grandfather's name has to be added. In Wales there are villages full of Davies, Griffiths, and Jones, and the particle *ap* (son of) comes into frequent repetition. In the old play of "Sir John Oldcastle" (1600) the judge asks a Welshman for bail, and Davy, well provided with cousins, replies readily with the name of "Her cozen ap Rice, ap Evan, ap Morice, ap Morgan, ap Llewellyn, ap Madoc, ap Meredith, ap Griffin, ap Davies, ap Owen, ap Shinkin Jones." "Two of the most efficient are enow," says the judge. "An't please your lordship these are but one," corrects the sheriff. To-day in Lancashire any man who inquires for Weaver Tom will eventually find that it is not "Tom o' Bill's o' Jack's" (Bill's son, Jack's grandson), but "Tom o' Bill's o' Tom's" that he wants, or some such distinction will occur between the various Toms, according to the local speech. Tom has a surname, but no one cares to know it, and the ancient custom is the strongest. In the Jewish synagogue it is the same. "Solomon" may be called upon to read the law. Perhaps half-a-dozen start up, and "Solomon ben Isaac" is called; if this is not definite enough, and there are several ben Isaacs, "Solomon ben Isaac ben Jehuda" will usually settle the matter. Napoleon found the Jewish neglect of surnames so serious a difficulty in the way of identifying German Jewish conscripts, that while he held the land he ordered all Jews in North Germany to take surnames on a certain day, under stringent penalties, and these surnames they have ever since borne. The Jewish "Ben" is the same as the Norman Fitz (Fitz Hardinge), the Scottish Mac (Mackenzie), the Irish O' (O'Connell), and the Welsh Ap or initial P (Price, Popkins = ap Rice, ap Hopkins); all of them simply mean "son."

In England every one now has a surname, but before the middle of the eleventh century such a thing was almost unknown. From the eleventh to the twelfth century surnames arose, and they spread so rapidly when they had once begun, that long before the end of the twelfth century it was as rare to find a man without a surname as it had once been to find a man with one. The distinction marking out a surname from a personal name is inheritance. Thus Moses the son of the baker Mendel calls himself Moses Mendel's-son (Mendelssohn), but this is a mere patronymic, like the Greek and Hebrew instances above given: it is a name, not a surname. When, however, Paul Mendelssohn inherits it from Moses, and calls himself not "Paul Moses' son," but "Paul Mendelssohn," the name is a genuine surname. It is now the name of a family, not of an individual.

Surnames in England divide themselves, as to their origin, into (1) personal names, chiefly patronymic; (2) local names; (3) names of trades and occupations; (4) nicknames.

We shall now proceed to briefly pass in review these four classes.

Surnames from Personal Names. A few genuine English personal names survive as surnames, as Aldred (Alured), Aylwin, Goddard (Gotthard), Godwin, Oswald, Osmund, Seward, Sebright, Howard (Hereward), Swain (Swegen), &c., and these rarely take the suffix *son*, nor are they changed by diminutives. Far more Norman names remain, but these exist mostly in their pet forms, and with the filial desinence *son* as well as in their original form. Many of them have quite disappeared as personal names. Brice, once a Christian name, remains unaltered as a surname, or takes the filial desinence as Bryceson; but Serlo exists only as Searle, Hervé as Harvey, Ingelram as Ingram, Almeric as Emery, Hamo or Hymon as Hammond or Hampson or Hamnet, Drogo as Drew or Drewett (diminutive), Guarin as Warin, Wareing, and Warren, Ivo as Ivison or Ives, Payen as Pain or Payne, &c. The Norman names in their conversion into surnames are largely altered by pet diminutives, as *kin* (Wilkins for Wilkinson, son of dear Will), *cock* (Willcock), *ot* (Mariott), *et* (Emmett), &c. Norman names still used as names and also as surnames are of course the largest division of the class. Ralph, Guy, Roland, Robert, Richard, Roger, &c., occur at once to the mind. These and many more exist in their pure unaltered state as surnames, but we have them also in many altered forms. The list above is clearly recognizable in Raff, Rollins, Rawlinson (Rawlin was the favourite pet name for Ralph), Randall, &c.; in Wyot, Wyatt (for Guyot); in Rowlandson, Rowlett, Rowley, &c.; in Robins, Robertson, Robson, Dobbs, Dobinson, Hobbs, Hobson, Hopkins, Hopkinson, Probert (ap Robert), &c.; in Richardson, Rix, Dick, Dickson, Dix, Dixon, Dickens, Dickenson, Hitchins, Hitchcock, &c. (Hitchin was a pet form of Richard); in Rodgers, Rogerson, Hodge, Hodges, Hodgkinson, Hoskins, Hodson, Prodgers (ap Roger), &c. These may serve for an example. It would be tedious to give these lists fully or to extend the example to other names, since every reader's experience will suggest amplifications.

The most common name in England immediately after the Conquest was William. John ran it close from the first and soon overpassed it, but William recovered its lead under the auspices of the house of Orange. Therefore John exceeds William in its power over surnames, as when these arose it was the prominent name. Yet we have crowds of Williamses, Wilsons, and Williamsons; and Wills, Wilmot, Willet, Willcocks, Wilkins, Bilson, and Wilkinson, &c., are present in large numbers. Against these John gives us Johns, Johnson, Jones, Jenkins, Jenkinson, Jennings, Jenks, Jack, Jackson, Jacox, Evans (the Welsh form), Bevans (ap Evans), Janson, Hanson (Johannes), Hancock, and the large series of Micklejohn, Brownjohn, Littlejohn, &c.

With the Angevin dynasty came in Geoffrey, Fulk, and Henry as royal family names, and these were at once as popular as Victoria, Albert, Alexandra, &c., among ourselves. The result on the surnames is a numerous crop of Jeffreys, Jephson, Jefferson, &c., Foulkes, Fawkes, Fausitt, Fawcett, Fowkes, Fox, &c., Henry, Harris, Harrison, Hallett, Halket, Halkins, Hawkins, Parry (ap Harry), Harriott, &c. Space forbids further discussion of this point.

A large part of the names of our people has always

been drawn from the calendar of the saints, and as it has already been abundantly shown that most surnames were patronymic, it follows that a considerable class of surnames must be formed of the names of the Christian saints. Some of these are now comparatively obscure to those who do not belong to the older form of the Christian faith. For instance, either of the three St. Geralds is much less known than the surnames Jerard, Garrett, Jarrett, &c., derived from them. A quite forgotten St. Walter (unearthed by Miss Yonge, "History of Christian Names"), of somewhere in Aquitaine, date about 990, had a countless number of namesakes, and is represented in a large number of surnames by consequence; Walters, Waters (the name was vulgarly pronounced Water, see the play on the word in the scene of the death of Suffolk, Shakespeare's "Henry VI.," Part II.), Watts, Watkins, Watson. St. Cuthbert is less known as giving us Christian names than surnames, Cuthbert, Cutbeard, Cuddy, Cobbett, &c. St. Dionys, Backchurch, was in Fenchurch Street, London, and has not long since departed, following its vanished congregation. It preserved the name of a once popular saint, but not so well as the derivative surnames Dennis, Dennison, Tennyson, Dyot, and Dyson have done. St. Theophania few know, but there are several Tiffanys. St. Lambert (also as Lampson, &c.), St. Gilbert (also as Gibson, Gibbons, Gibbs, &c.), St. Christopher (also as Kitson, &c.), St. Theobald (also as Tibbs, Tubbs, Tippins, Tibbats, Tibbet, Tebbutt, &c.), St. Hugh (also as Hughes, Hewett, Hewson, Huggins, Hewlett, Hutchins, Howett, &c.). St. Philip (also as Philipson, Phipson, Philpotts, Phelps, Philips, &c.), give us both Christian names to-day and surnames from centuries long past.

From the Scriptures directly we get our Adams, Adamson, &c., Abel, &c., Isaacs, Isaacson, Hickson, Hicks, Higginson, Higgs, &c., Davids, Davis, Davies, Davidson, Davison, Dawson, Dawkins, Dakins, Dawkes, &c., Solomon, &c., Job, Jobson, &c., with Elias, Ellis, Elliot, Ellison, Elkins, Elkinson, Elliotson, Ellicot, Ellcock, Allcock, &c., and numbers more. Nor are the unworthy characters omitted, whether from humiliation (as in the Puritan age, when the brother of Praise-God Barebones was named "If-Christ had-not-died-for-thee-thou-hadst-been-damned Barebones," and was always known as "Damned Barebones" among his lazier friends in consequence), or from a derogatory nickname. We thus have Cain, Eli, Absalom, Tamar or Damer, Shapira (Sapphira), &c., among us. Cleveland bitterly said of the Puritan habit of naming from the Scriptures, "Cromwell hath beat up his drums clean through the Old Testament—you may know the genealogy of Our Saviour by the names of his regiment (the Ironsides). The muster-master hath no other list than the first chapter of St. Matthew." They went further, and though their names of Scriptural virtues and holy catchwords no longer are used as Christian names we have a long list of surnames derived from them. Of such are Grace, Patience, Prudence, Increase, Faithful, Hope, Mercy, Holdfast, Meek, Joy, Death, Virtue, &c.

But every man has a mother as well as a father. In some cases, therefore, where the mother was the superior parent or was tenderly beloved, or where, perhaps, the father was absent, or circumstances of disgrace prevented his name from appearing, surnames were taken from the mother—metronymics, as they are called, not patronymics. Of such are Parnell (Petronella), Maudle or Maudlin (Magdalen), Tillott, Tillotson, Tilley, Tilson, Malkin, Makins (Matilda), Beaton (Beatrice), Emmott, Emmett, Empson (Emma), Sisson (Cicely), Gillott, Gill, Gibson (Gillian), Dowson (Douce), Custance (Constance), Neilson, Nelson (Eleanor), Julian (Julia), Mapson, Mapleson (Mabel), Magson, Margetson, Megson, Miggs (Margaret), Ibbotson, Isott, Bell, Belton (Isabel), Mariott, Marryatt (Mary), Evison (Eve), &c.

Surnames of Local Origin.—These form the next numerous class, and as they are very easily distinguishable need not so much consideration as the patronymics. First come the towns: John à York, Thomas à London of the old records easily pass into John York and Thomas London. Then Thomas atte Becket (Beck is a small stream, Becket a streamlet) becomes Thomas à Becket, and so plain Thomas Becket. The *a* or *atte* or *de* often remains with the name, as in Atwell, Attwood, Atlee, Delane, Attenborough (at the borough), Atterbury, &c. It is not so easy to see it in Noakes (atten oaks), Nash (atten ash), Nalder (atten alder) in their present worn-down state. The man who lived in the wooded vale or dene would be called John à Dene, and thus our Dean as a surname arises. If the dene held cows or oxen, brocks (badgers), swine or hogs, lambs, foxes, rams, John would be further described as Cowden, Oxenden, Brogden, Swinden, Hogden or Ogden, Lambden, Foxden, Ramsden, &c. Thus ley (a shelter) gives us Ley, Leigh, Horsley, Cowley, Harley (hare), Ashley, Oakley, Berkeley (birk = birch). Our Royds show where the forest had been cleared or *ridded*, Holroyd (holly), Acroyd (oak), Ormerod (the royd cleared by Orme), &c. When we cut metal or stone we "grave" it, and our forefathers graved a forest in like manner into groves, hence our Greaves, Gravesend, Grove, Grover, Hargreaves (hares), Congreve (cony). Thwaites is Norse for field; hence Thornthwaite, Thistlethwaite, &c. Slade was a level grassy sward in a forest, as Greenslade reminds us. Holms (Holmes, &c.) and plats (Platt) were river-meadows. Knolls (Knowles) were bare hills rising in the forest land. Cloughs were clefts among the hills: our Cliffes, Ratcliffes, Cliffords, Faircloughs, &c., keep the old name living. Cob or cop was a summit (Chaucer speaks of the cop of the nose), whence Cobden, Cobb, Cope, Copley, Copestakes. Dune, the sandy hill, gives us Dunn, Downs, &c. Combes, Moors, Yates or Gates, Heaths, &c. abound in our names as they still do in our country walks. We see, however, many a dovecot without recognizing the origin of Duffus (dove-house) or Duffy, and a malt-house does not suggest to us Malthus, which really came from it. Bacchus, a surname we sometimes meet, is actually from "del Bake-hus," and has nothing to do with the god of wine. Snooks proves to be but Sevenoaks written short. The Croft (meadow), Orchard, Garth (farmyard), Barn, Booth, Stead, Hall, Hay (hedge), Acre (farm land), Worth (farm building), &c., yield a large produce in surnames, pure or derivative, as might be expected from the great part played by agriculture in our early national life.

Many names have come from the necessity of distinguishing strangers. "Peter le Newe," "Gilbert de Newcomen" figure in our old records with "Roger le Wiltshire," or "William de Sutton," &c. Hence our Veness (Venice), Luck (Lucca), Legge (Liège), Challen (Chalons), Cullen (Cologne), Bullen (Boulogne), Lubbock (Lübeck), Strange, Kentish, Northern, Welsh or Walsh, Cornwall, Ireland, Fleming, French, Brabner or Brabaner (Brabant), D'Almaine (Allemagne, Germany), Lombard, Hansard (Hanse towns), &c. But not only a father's birthplace, but his place of business might yield a name to his son, and the son of "William atte Blue Lyonne" would be plain Richard Lyon. The Rose, the Bell, the Sparrow, the Neale (neele or needle), and their numerous congeners, are a large source of surnames.

Surnames from Occupations.—This is a very large class. The English Elder, Reeve, Sheriff, Judge, and Dempster (to *deme* was to judge), Fiddler, Wait (oboe player), and Harper give us surnames, as well as the Norman Sergeant, coroner (Corner), summoner (Sumner), and Justice, trumpeter (Trumper), and trouvère or troubadour (Trowers), &c. The church finds us Crozier, Priest, Sexton, Secretan, Collet (acolyte), Parsons, Latimer (reader of Latin), &c.; and more remotely Pilgrim, Palmer, Hermi-

tage, &c. The camp sends us Knight, Squire, Kemp (soldier), Kempson, Child (eldest son of a knight or lord: compare Infanta), Bachelor, Serymgeour, or Scrimshaw (skirmisher), &c. The hall has its Constable, Wardroper (wardrober), Spencer (spence = buttery), Butler, Massinger (messenger), Page, &c. The table gives us Knifesmith, Knyvett, Spooner, and Carver, but noticeably no Forker, for forks were not invented when surnames were arising. The frequency of our Bowyer, Fletcher (featherer of arrows), Arrowsmith, Stringer, Archer, Bowman, Bolt, Butts, &c., remind us of the supremacy of the bow as the English weapon in the era of surnames. Jenner was by origin the engineer who constructed the larger engines of war. The park gives us Forrest, Forrester, Warren, Parker, Woodward, Bailey (bailiff), Ranger, Hayward (ward of the hays or hedges dividing common land from private land), Hunt, Fowler, Falconer, &c. The house, chiefly of timber and with few windows, comes before us in the English names Thatcher, Thackeray, Hillier (*hele*, to cover), Tyler, Slater, and Shingler (wooden slates), but the Mason, Carpenter, and Joiner are Norman introductions. Dawber is an older name for plasterer, it may be remarked. The farm supplies us with Cottier, Cotman, Cotterel, Freeman, Franklin, Marler, and Chalker (those who spread marl or chalk over the fields), Akerman (acre or farm-man), &c., and with many different herds or tenders of animals the stotherd (Stoddart), who minded the stots or bullocks, the Yeatman with his yeats or heifers, the cowherd (Coward), calfherd (Calvert), coltherd (Coultard), Shepherd, goatherd (Goddard), swineherd (Swinnart, Hoggarty, Goldart), as well as the Twentyman or keeper of twenters (two-year-olds, *i.e.*, two-winters). The orchard of early days is with us in Viner (though English wine is now made from anything else than grapes), Orchardson, Applegarth, Perrier, Beeman, &c. The charreter or carter (Charters and Charman), the Horseman, the Plowman, are also familiar in our directories.

The various trades of the middle ages are all well shown in our surnames. The Miller (Milner, Milnes) with his subordinates the bolter (Boulter), riddler (Riddel, Ridley), Vanner, and Shoveller; the Fisher (Fiske); the Wrights, as the Wheelwright, Boatwright, Cheesewright; the Smiths, as the Arrowsmith, Whitesmith, Goldsmith (Offor, also = orfèvre) Billsmith (bill = pike), Nailsmith (Nasmyth, Nayler, &c.), sicklesmith (Sixsmith), &c.; the latener (Latoner) who worked in the lead-copper metal called latten; the leadbeater (Leadbetter); the Saddler, Lorimer (bit), Spurrier (spur), Shoosmith (who made horse-shoes), Marshall and Farrier (who put them on); the Woolman, Packer, Carder, Towzer, Webber (or Weaver, or Webster), Lister or Dyer, Walker or Fuller or Tucker, Shearman, Flaxman and Spinner, with the maker of Burrell or Borell, a cheap brown cloth; the Souter (shoemaker), Girdler, Purser, Pell or Pelter (skin dresser), Furrier, Lacer (Lacey), Challoner or Quilter (one sort of quilt was first made at Chalons), Hosier or Chaucer (= calceolarius), the Couchman and Holder (upholsterer), the Capper, the Tailor and Draper —all of them supplied by the Aguilar, Neele or needle-maker (*aiguille*); the Baker or bakester (Baxter), Cook, Mitchiner (*mitch*, a fine loaf), Firminger or cheesewright (*fromage*), Spicer or grocer, Salter, Soper, Butcher (Bouche, Labouchere), Poulter, Slaughter, &c., the Brewer (Brace, Brassey, Brewster) and Maltman; the Barber and Leech; the Bowler, who made bowls (Bowles, Bowley), chalice-maker (Challis), Crocker (who sold pottery), Cooper (and his mate the Hooper), Cadman (who made cades or barrels, Jack Cade being one of his tribe), Maunder (who made maunds or baskets), Butler or bottler (who made bottles, *i.e.* of leather); and the Merchant in general, the Skipper or shipper, the Cocker or cock-boat man, the Leader or Carrier, and the Gage or Weightman—form a list which brings up almost as a picture the life of our forefathers, surviving in the surnames which, by coming into being at that time, crystallized its "form and fashion." The regular tradesman had to compete with the Traveller, the Pedlar, the Chapman, the Packman, the Sumpter, the Stallman or Boothman, or Dodman. The Champion and Wiseman (conjurer), the Fiddler, Tabrer, Piper, Trumper, and Crowder (*crowd* or *crwth*, an early viol) of the ancient fairs survive in our surnames.

Surnames from Nicknames.—This is the last great class of surnames. How common nicknames were among our ancestors may be seen by the familiar names of our kings, the Ironsides, the Unready, the Harefoot, the Confessor, the Conqueror, the Redhaired, the Scholar, the Lackland, the Lionheart, the Longshanks, the Crookback, &c. So among the commonalty we find many a Crookshank or Cruickshank, Sheepshanks, Whitehead, Cheek, Jowlet, Swift, Longman, Shortman, Bigg, Little, Round, Low, Lightfoot, Crump, Cameron (crooked nose), Campbell (crooked mouth), Stutter, &c. Relationships are pretty fully represented; the following are not so easily recognized among them: Neve (nephew), Cozens (cousin), Eames and Ames (uncle). The poor, the rich, the ragged (Ragg, Wragge, Ragget) were often with our fathers evidently, as they are with us. A man's peculiarity of handling his weapons soon made him a Wagstaff, a Benbow, a Shakespeare, or a Waghorne; or his natural peculiarities pointed him out as White, Blank or Blanch, Red, Reed or Reid, or Redhead, Black, Blackman, Morell, Bayard, Russell (ruddy), Layard (dapple gray), Dunn, Blond, Blount, Blunt or Blundell, Whitelock, Fairfax (fax—head of hair), Knott (close cropped), Caffyn (*chauvin*) or Ball (bald), or simply Tait (tête = head), &c. Or he might excite attention for his character and at once be singled out as Good or Bunn (*bon*), Best, Wise or Sage, Blythe or Merry, Truman or Friend, Curtis (courteous), Sweet, Quick, Sharp, Sly, Sleigh, or Snell (schnell), Clark (studious), Freke (daring), Parfitt (perfect), Moody (contemplative), Prew (*preux*), Keen or Kean, Witt, Wellbeloved, Bonamy (*bien aimé*), Playfair (play-fere, playfellow), &c. Or on the other hand he might be a Proudman or Proudfoot, Pennifather or Halfpenny (miser), Wild, Savage or Ramage, &c. If he were given to strong language he might for ever be styled a Pardoe (par Dieu), Bigod, Goodbody (God's body), Godbehere or Goodbyear. A fancied resemblance, or a reminiscence of an actor's calling would give us Allan le Pope, or William le King, or John le Byshoppe, as we find them in old documents. So also either dealing in animals, or resembling them in some way, or having used them as a trade sign, would account for our frequent animal surnames. Of these are Oliphant (elephant), Lyons, Wolff, Lepard, Hare, Buck, Wray, Doe, Roe, Catt, Fitch (polecat), Tod or Fox, Wildbore, Brock or Badger, Coney or Rabbett, &c. The birds give us Pye, Nightingale, Bullfinch, Cock, Peacock, Rooke, Swan, Coote, Crave, Drake, Mallard (wild duck), Partridge, Raven, &c. The fishes give us Herring, Codd, Codling, Salmon, Sprat, Crabbe, &c., or Codlin and Crab may belong to fruits, whence we also get Cherry, Peach, &c. These fruits and the few trees, Ash, Birch, Holyoak, Broome, &c., are more probably accounted for by local circumstances than as nicknames.

The subject is one of absorbing interest both in itself and as representing in so extraordinarily complete and yet so indirect a manner, the lives of the men of the twelfth and thirteenth centuries. It is, moreover, one which only research will serve to elucidate; guesswork is of not the least use. Only tracing back the name to its spelling in ancient deeds and records will serve truly to elucidate its origin. Some names arise in more than one way. Thus Bell comes from three sources: 1, nickname, as Peter le Bel (Hundred Rolls, &c.); 2, metronymic, as Richard fil. Bell, *i.e.* son of Isabel (Hundred Rolls, &c.); and 3, local, as Richard atte Belle (Writs of Parliament).

Pronunciation of some Surnames.—As surnames have in most cases preserved the pronunciation of the times

when they originated, they often differ widely from our speech of to-day. In old times we spoke of a *marchant* (merchant) as we still speak of his *clark* (clerk); consequently Derby, in speaking either of the peer, the town, or the race, should always be called Darby; Berkeley, Barkley; Hertford, Harford; and Jervis, Jarvis, &c. But though the pronunciation of many surnames is explicable by this rule, that of others seems due to caprice. A list of some of the best known surnames which present peculiarities of pronunciation may be useful, and is certainly odd and interesting:—

Dillwyn is pronounced Dillon, with the accent on the first syllable. In Blyth the *th* is dropped, and the word becomes Bly. Lyveden is pronounced as Livden, and Pepys as Peps. In Monson and Ponsonby the first *o* becomes short *u*, and they are called Munson and Punsonby. In Blount, Bourne, and Bourke the *o* is silent, and the words are spoken as Blunt, Burn, and Burk. Brougham, whether referring to the late illustrious statesman or the vehicle named after him, should not be pronounced as two syllables—Brawham or Broohan—but as one—Broom. Colquhoun, Duchesne, Marjoribanks, and Cholmondely—four formidable names to the uninitiated—must be called Cohoon, Dukarn, Marshbanks, and Chumley. Cholmeley is also pronounced Chumley. Mainwaring and M'Leod must be pronounced Mannering and Macloud. The final *x* in Molyneux and Vaux is sounded, but the final *x* in Devereux and Des Vaux is mute. In Ker the *e* becomes short *a*, and the word is called Kar; it would be very bad form to pronounce it Cur. In Waldegrave the *de* is dropped, and it becomes Walgrave, with the accent on the first syllable. Buchan is pronounced Bukkan; Beauclerk or Beauclark, as Bowclare, with the accent on the first syllable: but Beauchamp is Beecham, and Beauvoir, Beevor. Wemyss is pronounced Weems, and Willoughby D'Eresby as Willowby D'Ersby. Montgomery is Mungumery, with the accent on the second syllable. In Elgin *g* takes the hard sound it has in *give;* in Gifford and Giffard it takes the soft sound, as in *gin*—as it also does in Nigel. In Conyngham the *o* becomes short *u*, and the name is called Cuningham. In Johnstone the *e* is silent. Strachan should be pronounced Strawn, and Heathcote, Hethcut. The *ar* is dropped in Abergavenny, which is called Abergenny; and the *n* in Penrith, which is called Perith. Gower, as a street, is pronounced as it is written, but, as a surname, it becomes Gor. Eyre should be pronounced Air. Jervis should be pronounced Jarvis; Knollys as if written Knowls; Menzies as if written Ming-ies; and Macnamara must be pronounced with the accent on the third syllable. Sandys should be spoken as one syllable—Sands; St. John is Sinjon; St. Clair, Sinclair; and St. Leger, Selleger. Vaughan is spoken as one syllable—Vawn; Villiers as Villers, with the accent on the first syllable; Tyrwhitt is called Tirritt; and Tollemache, Tollmash, with equal accent on both syllables. The proper pronunciation of a certain dead Conservative premier's title is Beekonsfield; Bethune should be spoken as Beeton, and Milnes as Mills. Charteris is pronounced as Charters, and Glamis, Glams. Geohegan is always spoken as Gagan, and Ruthven as Riven.

The Frenchified form of many of our surnames, especially among the aristocracy, is of course due to the fact that many of the followers of William the Conqueror were known by the titles of their French estates. One came from Montgomery (De Montgomery), another from La Bèche (De la Bèche), another from Angerville (Dangerville or Dangerfield), another from Antwerp or Anvers (Danvers); and these territorial titles passed later on into surnames. After the Conquest our new Norman lords called themselves after their new fiefs, De Hastings, De Winton, &c., and often a grotesque effect is produced by the lordly "de" attached to some homely English name.

The most readable book on the subject is Bardsley's "English Surnames" (London, 1883), from which much of our information has been derived. Other good authorities are Lower's *Patronymica Britannica* (London, 1860), where the subject was first brought into scientific form, and which remains, though with many errors, the standard work for the student, and Robert Ferguson's works "English Surnames" (1858), "Teutonic Name-system applied to the Family Names of England, France, and Germany" (1861), and "Surnames as a Science." Miss Charlotte M. Yonge's "History of Christian Names" (1863) is very useful in investigating the closely allied subject of surnames.

SUR'PLICE (Low Lat. *superpellicium*, as if from *pellis*, the skin), an ecclesiastical vestment of white linen or muslin, worn by clerks of all degrees of orders during certain religious offices. In the Anglican Church it is only used by the ritualists during the delivery of the sermon. At the close of the service, and after the administration of the Eucharist, the low churchman exchanges it for a black gown. The retention of the surplice was vehemently opposed by the Puritan reformers in England, and by the Calvinists on the Continent, and it is still most unreasonably associated with Roman Catholic tendencies by many of the laity. It dates from the twelfth century.

SUR'REY, an inland county of England, bounded N. by Middlesex, from which it is separated throughout by the river Thames, E. by Kent, S. by Sussex, W. by Hampshire, and N.W. by Berkshire. The length, east to west, is 39½ miles; the breadth, north to south, is 25½ miles. The area is 483,178 acres. The population in 1881 was 1,435,842.

Surface and Geology.—The part of the county which lies north of a line drawn from the Kentish border near Beckenham, leaving Croydon a little to the south, and passing by Leatherhead, and from thence to the Hampshire border near Ash, somewhat to the north of Guildford, belongs, with few exceptions, to the London clay formation. This district is comparatively low, but forms the line of elevations extending on the south side of London, from New Cross, near Deptford, by Nunhead, Denmark Hill, Herne Hill, Brixton Hill, Clapham Rise, Wimbledon Common, and Richmond Hill. It also forms the hills running southward along the Kentish border from New-cross by Forest Hill, Sydenham, Penge, and Norwood. Not one of them is of much elevation, though commanding extensive prospects. The hills about Norwood are 389 feet above the level of the sea.

North of the high lands which extend from New Cross to Battersea the London clay is covered by alluvium; and it is probable that the greater part of this flat was, antecedently to the Roman period, overflowed by the Thames at every high tide, and formed an extensive marsh, which was gained from the waters by embankment. Along the bank of the river also, between Putney and Richmond, alluvium is superimposed upon the London clay.

The range of high grounds known as Esher Common, Cobham Common, St. George's Hill, Woking Heath, Pirbright Common, and Ash Common, which extend with slight interruption from the neighbourhood of Kingston to the Hampshire border, including St. Ann's Hill, Shrubs Hill, and the other hills west of Chertsey and Bagshot Heath, and the elevated ground of Cobham Ridges between these two ranges, are all formed of the silicious sand and sandstone belonging to the upper marine formation, which here covers the London clay. The highest elevation does not exceed 468 feet. This formation presents a poor, hungry, unimprovable sand, and hence extensive wastes are allowed to remain, notwithstanding the proximity of the metropolis and the consequent impulse to cultivation. South of the boundary line of the London clay the plastic clay crops out, and occupies a long narrow district extending across the county from the Kentish to the Hampshire border.

South of the plastic clay the chalk range of the North Downs rises. • These Downs extend from Kent across the county into Hampshire, interrupted only by the depressions through which the rivers Mole and Wey pass, and by a depression near Farnham. The breadth of the chalk district is greater on the eastern side of Surrey, and the downs there attain their greatest elevation. Botley Hill (880 feet), above Titsey, is the highest point. The breadth of the chalk district here is about 4 miles. Box Hill, near Dorking, overlooks the depression through which the Mole passes. Between Dorking and Guildford the range of the Downs gradually narrows; and between Guildford and Farnham it forms a remarkable narrow unbroken ridge, above 6 miles long and about half a mile broad, called the Hog's Back. The Downs rise again beyond Farnham, just on the border of Hampshire, into which they extend.

From beneath the south escarpment of the North Downs the chalk marl and green-sand formations crop out. They occupy the valley which extends at the foot of that escarpment all through the county, and which to the east of Reigate is called the vale of Holmesdale; but as the formations extend southward from the chalk they swell into considerable eminences, of which Leith Hill (993 feet) is the highest point in this part of England, and they stretch across to Hind Head Common (923 feet), on the Hampshire border.

The rest of Surrey, comprehending the whole of the southern districts, except a very small part west of Haslemere, is occupied by the weald clay and iron-sand formations. The latter only just appears at the south eastern corner of the county. The weald clay occupies the broad valley at the foot of the green-sand hills, and in some places forms the lower part of the south side of the hills. The stratum of gray chalk marl, locally termed *firestone*, extends along a narrow terrace from Godstone to Merstham.

Thus the strata of the county may be regarded as constituting three principal groups—namely (1) the *wealden*, which is the lowest and most ancient series of deposits; (2) the *chalk*, which is superimposed thereupon; and (3) the *London clay* or *tertiary beds*, distributed in basins or depressions of the chalk. Upon these last-named strata occur, here and there, accumulations of ancient drift, consisting of loam, gravel, and sand, which are designated *post-tertiary detritus* or diluvium. These various deposits admit of subordinate divisions, which are distinguished by their peculiar mineralogical characters and organic remains. There are excellent quarries of freestone and limestone in different parts of the county.

Rivers.—Surrey is included in the basin of the Thames, except three very small portions; two lying south of the green-sand hills, which are drained by streams flowing into the Arun, and a third in the south-east, which belongs to the basin of the Medway. The Thames, which forms the northern boundary, is navigable throughout for small craft, and up to London Bridge for sea-borne vessels. It divides Surrey from Berkshire and Middlesex, washes the pleasant places of Egham, Chertsey, and Weybridge, Hampton, Kingston, and Richmond, and flows past the suburban towns of Barnes, Chiswick, Putney, and Wandsworth to enter the metropolitan district at Battersea. Those of its tributaries which belong to Surrey are the Bourn Brook, the Wey, the Mole, the Hog's Mill River, and the Wandle.

The Bourn Brook rises near Bagshot, and flows by Egham, Thorpe, and Addlestone into the Thames below Chertsey; its whole length is about 14 or 15 miles.

The "chalky Wey, that rolls a milky wave," springs from two sources—one near Alton, in Hampshire, the other at Haslemere, in Surrey, and flowing through the Farnham valley, passes Moor Park and Waverley Abbey, and proceeds east to Godalming. Then it winds to Guildford, receiving in its course two lesser streams, and runs onward in a northerly direction past Stoke, Send, Woking, Witley, and Byfleet, to join the Thames a mile below Weybridge. The whole length of the Wey is 41 miles, for about 18 of which it is navigable.

The Mole, anciently called the Emlyn River, rises in the northern part of the county of Sussex, near Hand Cross, and flows north about 5 miles to the border of Surrey, which it enters near Gatwick. It then proceeds north and north by west to Dorking. From Dorking it winds round the base of Box Hill, and north past Leatherhead, to the Thames at East Moulsey, opposite Hampton Court. Its whole course may be estimated at 42 miles. It is not navigable in any part. In penetrating through the chalk range of the North Downs beyond Dorking it is subject to be occasionally absorbed by the spongy and porous soil through which it flows, disappearing through numerous openings in its banks and beds which are known as swallows.

The Hog's Mill River rises in a copious spring in the village of Ewell, and flows north-west 7 miles into the Thames at Kingston. It is not navigable.

The Wandle rises near Croydon, flows 3 miles west to Carshalton, where it receives several streams, then turns and flows 8 miles N.N.W. by Mitcham, Merton, and Wandsworth into the Thames; its course is only 11 miles, and it is not navigable.

Canals and Railways.—The canals are the Grand Surrey Canal, 1 miles 6 chains in length, from the Thames to a basin at Camberwell; the Wey and Arun Canal, from Guildford to New Bridge, in Sussex, 18 miles; and the Basingstoke Canal, 37 miles. The London and South-western Railway passes through the county, and sends off branches to Guildford and Reigate, where a communication is formed with the London and Brighton and South Coast Railway. From Guildford a line passes by Godalming direct to Portsmouth, and there are branches from London to Richmond and Staines, Kew, and other places. Portions of the South-eastern Railway are included in the northern district near the Thames, while branches of the London, Chatham, and Dover connect London with Clapham, Brixton, Wandsworth, Dulwich, and the Crystal Palace.

Agriculture.—The climate of Surrey is favourable for corn and grass. Along the Thames and the other rivers the air is soft and mild. Where the ground rises into gravelly hills or lies on the range of chalk which runs along the centre of the county, it is keener. The soil varies greatly in different districts. The richest is that which lies along the river banks, consisting chiefly of a deep alluvial loam. On this soil, in the neighbourhood of London, are some of those extremely productive and highly cultivated market-gardens which supply the metropolis with fruit and vegetables. The immense quantity of manure which is annually laid on the land so occupied, and the deep trenching and digging which are repeated at short intervals, have converted the whole surface, to the depth of 3 feet or more, into a rich black vegetable mould. Here are raised the best and earliest culinary vegetables, which so rapidly succeed each other that five or six different crops are sometimes gathered from the same ground in one year. There is another naturally rich black soil, which appears in small detached portions along the foot of the chalk hills. Its quantity is, however, small. The next in fertility is a hazel loam, with a considerable portion of calcareous earth in its composition, which occurs on the northern side of the hills about Cobham, Ripley, Woking, and Horsell. The well known hop grounds, first planted about 1595, in the neighbourhood of Farnham, are mostly on a similar soil.

The most extensive tract is that of the weald clay, which contains a smaller mixture of silicious sand than other clays. It extends into Sussex and Kent, and occupies most of the southern parts of the county. In its natural state this soil is of little value, and can only be rendered productive by very complete draining, and by

correcting its tenacity with chalk or gravel, where they can be found at hand, which, however, is seldom the case. The weald is generally low and flat; where it rises into hills the soil is more fertile. In the northern portion of the county, extending towards Hampshire, occurs a large tract of sandy loam of various qualities, some of which remains to this day in barren heath and common. Some sandy loams of a better quality lie between the Bagshot sand and the chalk hills, as about Esher, Dorking, and Reigate; in the vicinity of Godalming it becomes of a very good quality, resting upon a sandstone. The poorer sands are deposited chiefly upon a yellow ferruginous gravel. The crests of the chalk hills are either covered with a short pasture, as grassy downs, or, where the soil is of sufficient depth, have been brought under the plough.

Surrey is a favourite county for the residence of wealthy citizens and merchants. It possesses many beautiful sites, and the views from some of the hills are very extensive, such as Richmond Hill, St. Ann's Hill, Cooper's Hill, and Leith Hill. The villas within a few miles of London are very numerous, but most of them have only a small quantity of pasture land and pleasure-ground attached to them. Within a certain distance from London the larger properties have been subdivided, and their value greatly increased from the competition of purchasers.

[illegible] p[illegible] b[illegible] ids h[illegible] b[illegible] idered [illegible]ducti[illegible] some spots by trenching and judicious planting. Where the iron pan, as it is here called, or the moorband, which is an almost invariable concomitant of heath, is broken through, trees thrive well; where this is not done planting is generally an entire loss.

The agriculture of Surrey is generally in a very advanced state—the newest implements and methods of culture being readily adopted. The proximity of much of the county to London insures high prices and a good supply of manure. In the valley of the Thames there are still some productive market gardens, but much land that was formerly employed for this purpose has been built on during the last ten years. There are also some large nurseries in various parts of the county.

The hop gardens of Surrey lie chiefly in the neighbourhood of Farnham. The greater value of Farnham hops in the market is owing partly to the soil being peculiarly suited to this plant, and partly to the greater care with which it is cultivated. The chief varieties are the woodbine grape hop, the redbined orchard hop, and the neverblack.

A great variety of medicinal and aromatic plants are grown in the neighbourhood of Mitcham, principally camomile, poppy, horehound, wormwood, aniseed, peppermint, and lavender. The common box-tree flourishes vigorously at, and originated the name of, Boxhill. Fuller's earth, in request in all the cloth working districts, has been dug for centuries near the villa[illegible] of Nutfield, which is still the chief source of supply.

The Wealds of Surrey were, till within a comparatively modern date, one continued forest, and were gradually cleared and cultivated as timber grew in request and land was wanted to raise corn, which, little more than a century ago, the Wealds did not produce in sufficient supply for the inhabitants, although the population was small. Of late years the woods have been greatly thinned, and the process of grubbing has gone on most rapidly. The new plantations are either merely ornamental, near the seats of opulent proprietors, or grown on the barren sandy soil.

No peculiar breed of cattle is found in Surrey. There was once a peculiar kind of heath sheep, which had a small fleece of fine wool and very delicate flesh when fatted. Its meat was well known by the name of the Bagshot mutton, "sweet, but little mutton," says Aubrey, "much taken notice of by travellers." Only a small remnant of this breed is left, as many of the heaths and commons have been divided, although not cultivated, and the sheep have no longer their former wild and extensive range. The Dorking breed of fowls is in high estimation; they are large, handsome, perfectly white, and are distinguished by having five claws to each foot.

Except in so far as it is connected with the metropolis, Surrey has few manufactures, and those of little or no importance. The separate towns are of small extent, though numerous and of ancient date.

Surrey is divided into fourteen hundreds, subdivided into 143 parishes. It is included in the diocese of Winchester, forms an archdeaconry, and comprises the three deaneries of Southwark, Ewell, and Stoke. It is in the home circuit, except that for criminal offences the parts of the county nearest to the metropolis are in the district of the Central Criminal Court. The spring assizes are held at Kingston; the summer assizes in alternate years at Guildford and Croydon. For parliamentary purposes the county was divided, in 1885, into six divisions, each division having one member. The county also contains sixteen boroughs with one member each—making twenty-two members altogether.

Antiquities and History.—The ancient memorials of the county are very numerous and of high interest. British remains may be seen at Hanstiobury Hill, at Coulsdon, and at Castle Hill in the parish of Hascomb. The Stone Street, a Roman road from London to Chichester, passed through Streatham and Dorking. Roman relics have been discovered at Ewell, at Woodcote near Epsom, at Walton-on-the-Thames, and at Albury. In mediæval military architecture the castles of Guildford and Farnham stand conspicuous. The most noticeable buildings of a domestic character are—the hall of the archiepiscopal palace, Croydon; Wolsey's gateway tower at Esher; Archbishop Abbot's hospital at Guildford; Crowhurst Place, a Henry VII. mansion; Cowley House, Chertsey, dating from the reign of James I.; and the Elizabethan houses at Loseley, Beddington, Anne of Cleves' house, near Bletchingley, and Swain's Farm, near Leigh. The coronation stone at Kingston is a Saxon relic. The churches of the county are mostly worth the archæologist's attention. Among those with Norman portions are—Great Bookham, Chipstead, Compton, Peperharrow, Stoke d'Abernon, and Walton-on-the-Hill; Early English—Abinger, Carshalton, Crowhurst, Farnham, Horley, Kingston, Merstham, Oakham, and Woking; Decorated—Leatherhead, Nutfield, Reigate, and Shere; Perpendicular—Bletchingley, Crowhurst, Croydon, Godalming, Kingston, Leigh, Lingfield, Putney, and Thames Ditton.

The history of Surrey cannot be described as rich in incidents of national importance. A condensed summary, however, may not be without interest to the reader.

When Cæsar invaded Britain he pushed forward towards the Thames, and crossed it, probably, at Cowey Stakes, near Walton. He was vigorously resisted by a British tribe, supposed to have been the Regni of Ptolemy, at that time inhabiting Surrey, Sussex, and the coast of Hampshire. When the Romans subjugated Britain, the Regni were suffered to retain their native chieftain, on payment of a yearly tribute. This circumstance may account for the generally received fact, that the Romans formed few great settlements in Surrey, where scarcely the relic of any villa of importance has been discovered. Two of their great military roads, however, crossed the county: the Watling Street, through Old Croydon, Streatham, and Newington, to Stone Street, in Southwark; the Ermyn Street, commencing at Chichester, ascended the Sussex Downs, passed Bignor on the right, entered Surrey at Oakwood, ran forward to Dorking, crossed the Mickleham Downs, and then, by the back of Woodcote Park, in Epsom, led straight to Woodcote Warren and Old Croydon. Another branch of this great road ran from Newhaven to East Grimstead, and entered Surrey at New Chapel, 5 miles

from Godstone. Crossing Libbwestow Hill, it probably ran onward through Stratton (Street-town?) over White Hill, and through Chaldon and Coulsdon to join the Ermyn Street at Woodcote. Mr. Bray, in his "Survey of Surrey," also indicates a line from the Stone Street branching off between Okewood and Okeley, and passing through Newdigate, Reigate, Gatton, Chipstead, and Leaden Cross to Old Croydon.

After the English Conquest Surrey formed a portion of the South Saxon kingdom, though possibly governed by its own princes or reguli, and received the name by which it is now known—Sudrea, Suthrea, Suthrige, Sudrie, or "the kingdom south of the Thames." Few historical events of any moment distinguish its annals during its independent existence. About 567–68 a great battle was fought at Wibbandune, or Wimbledon, between two competitors for the throne of Kent. "This year," says the English Chronicle, "Ceawlin and Cutha, his brother, fought against Ethelbert, and drove him into Kent, and they killed two ealdormen at Wibbandune, Oslaf and Cnebba." Holinshed tells us that "this was the first battell that was fought betwixt the Saxons one against another in this land after their first coming into the same." Twenty-two years later, Ceawlin seized upon the South Saxon territories, and annexed them to his own kingdom (Wessex), though the South Saxons can scarcely have submitted without resistance to the spoliation. As late as 607 we are told that Ceolwulf, his successor, "fought against the South Saxons."

In 661 Edelwalch, their sovereign, was compelled to surrender his crown to Wulfhere, king of Mercia; but the latter appears to have governed by means of a viceroy, Frithwald being described as, in 666, sub-regulus of Surrey. On the death of Wulfhere the South Saxons recovered their independence, and retained it until 760, when they were finally subdued by Kenulf, king of Wessex. Kenulf, after a reign of thirty years, was slain at Merton by Cyneard "in a domestic feud." The victor himself, and eighty-four of his men, perished in the strife.

About 851, when Surrey had merged into the great kingdom of Wessex, the Danes landed in England, and crossing the Thames were met at Ockley in this county by the English under Ethelwolf, and totally defeated.

Surrey afterwards formed a part of the extensive domains of Earl Godwin and his son Harold, the last of the English kings. For a century previous its chief town had been the seat of the coronations of the English sovereigns, and a royal "vil" of some importance, deriving thence its name of Chingestun or Kingston. Edward I. was crowned there in 900; Athelstan in 925; Edmund I. in 940; Edred in 948; Edwy in 955; Edward the Martyr in 975; and Ethelred the Unready.

During the rule of the Danes, Surrey was the scene of two historical events. Through the Southwark marshes Cnut, the Danish king, cut the deep, broad canal by which he carried the ships beyond the strong defences of London Bridge into the river on its western side. "They sank," says the English Chronicle, "a deep ditch on the south side of the river, and dragged their ships to the west side of the bridge."

At Clapa's-ham, Lambeth, 1041, died Harthacnut, last of the Danish sovereigns of England, perishing suddenly, in a fit of intoxication, at the marriage feast of Osgood, Clapa's daughter.

Surrey suffered terribly from the ravages of the Norman soldiers after the battle of Hastings, in 1066; and was afterwards apportioned among the hungry and greedy vassals of the Conqueror.

A small island on the Surrey side of the Thames, and a broad meadow in the parish of Egham, were the scene, on the 15th day of June, 1215, of an event ever memorable in the annals of our country; the signature of "the Great Charter of English Liberties," of which Sir James Mackintosh has justly said—"To have produced it, to have preserved it, to have matured it, constitute the immortal claim of England to the esteem of mankind."

Proceeding onward in our brief chronology, we find that in 1216, when the English barons, wroth with the duplicity of John, invited Louis, the dauphin of France, to accept the crown, his forces took possession of three Surrey fortresses—Reigate, Guildford, and Farnham. In the following year they were recovered by Henry III.

In 1381, during the brief tyranny of Wat Tyler, Lambeth Palace and Southwark borough were plundered by his followers.

Kingston was visited by Sir Thomas Wyatt and his followers in 1544, when he attempted to compel Queen Mary into an abandonment of the proposed alliance with Philip of Spain. The bridge was broken, but he repaired it, crossed the Thames, and advanced upon Western London, to gain a quick trial and an ignominious death.

The first skirmish of the Civil Wars took place in this county, at Kingston-upon-Thames (January, 1642), when some Royalists attempted to assemble an armed force to seize upon the "magazine of arms" deposited in the town. Their leader, however, was apprehended and committed to the Tower, and the attempt failed. But throughout the Civil War Kingston remained faithful to Charles I., and in consequence was frequently occupied by both parties. An engagement took place in its neighbourhood in October, 1642, between some Cavaliers under Prince Rupert and a Parliamentarian detachment. In the same year Farnham was occupied by the Royalists, and Sir John Denham named its governor; but in December the forces of the Parliament retook the castle, and George Withers, the poet, was appointed to the command. The fortifications were demolished in 1648.

At Putney, in 1647, Fairfax and his officers stationed themselves, with the view of influencing the deliberations of the Parliament. The Roundhead leader and his lieutenants held their councils in the church, sitting around the communion table, and listening, before they commenced their debate, to the harangues of Hugh Peters, or some equally vehement ecclesiastic.

The last outbreak of the Civil War took place where the first had been witnessed, at Kingston, July, 1648. The principal leaders were the Earl of Holland, the Duke of Buckingham, and his brother, Lord Francis Villiers. They had assembled 600 horsemen at Reigate, but were driven back from Dorking by a detachment from Sir Michael Livesey's regiment. Retreating upon Kingston, they were pursued by a considerable body of Roundheads, and lost some men in a skirmish near Ewell. On a hill near Kingston they made their final stand, "but after a gallant defence, and as sharp a charge," saye one of the Parliament, "as ever I saw in these unhappy wars," were routed. They retreated to Kingston, but withdrew during the night, having lost Lord Francis Villiers and twenty others slain, and 100 made prisoners.

Surrey gives the title of earl to the Duke of Norfolk. The earldom was first enjoyed by William de Warrene, upon whom it was conferred by William Rufus in 1087. The title has been rendered illustrious by the virtues and genius of that poet earl beheaded by Henry VIII., who celebrated in undying verse the beauty of "the Fair Geraldine."

SURREY, HENRY HOWARD, EARL OF, although he died on the scaffold when but thirty, has earned an immortality in English literature as the introducer of blank verse, and the assistant of his friend, the greater and older poet, Sir Thomas Wyatt, in the acclimatization of the sonnet; and his unhappy fate further interests one in him.

The friend of Richard III., "Jockey of Norfolk," fell at Bosworth, and was attainted after his death. His son,

prisoner at Bosworth, was already Earl of Surrey in his own right, and retained that title all through Henry VII.'s reign. But his brilliant services at Flodden induced Henry VIII. to restore their dukedom to the Howards, and Surrey became the second Duke of Norfolk in 1514. This was the grandfather of the poet. Surrey's father also fought well at Flodden, and was highly distinguished even before his succession to the dukedom in 1524, having been Lord Lieutenant of Ireland and Lord Treasurer, and led armies against France and against Scotland. As Duke of Norfolk he became the head of the Catholic party, pronounced sentence on Anne Boleyn, and suppressed the "Pilgrimage of Grace" (1536-37), &c. The eldest son of this great personage was the poet.

Henry Howard, by courtesy Earl of Surrey, the subject of this article, was born 1517, and was cupbearer to the king in 1526. In 1535 he married Frances Vere, daughter of the Earl of Oxford, who bore him two sons (the eldest destined to become fourth and last of the first series of dukes of Norfolk, dying as a traitor because of his plot with the Queen of Scots in 1572). Lady Frances survived the earl twenty years. Surrey, and indeed all the Howards, were now in high favour. The king seemed to be veering back towards Catholicism, and when the divorce of Anne of Cleves was followed by a marriage with Catharine Howard, Surrey's cousin, the hopes of Norfolk's party beat high. But the new queen justly forfeited her life for ill conduct, and perished on the block in 1542; and Henry's favour abruptly turned. Surrey was imprisoned for seeking to fight a duel, and only averted mischance for the time by joining his father in the Scottish war. The victory of Solway Moss and death of James V. (1542), saved the Norfolks for a time. Nevertheless Surrey was flung into prison the very next year on a charge of roystering in the city, which, though true, was made the most of by the anti-Catholic citizens. Again he "purged his contempt" by joining his father in the field, this time in France. In 1544 he commanded in chief himself at the relief of Boulogne, and held the city as governor till 1546. The Seymour family and the Protestant interest were now in the ascendant. Queen Jane's brother, Lord Hertford (soon to become Protector and Duke of Somerset), was roughly set over Surrey at Boulogne, and the earl flamed out into some hot words which caused him to be imprisoned at Windsor. Some one called the tyrant's attention to the Howards quartering the royal arms, a family practice arising under Richard II., and by that king's authority, a century and a half before, and warranted by the Howards having royal blood in their veins. This was enough. Norfolk as well as Surrey was thrust into the Tower, and both hurried to their trial with indecent haste. It took some time to get together the peers who were to try the duke, but unhappily the earl as a commoner was brought at once before an ordinary jury and found guilty of this absurd charge of treason. Henry VIII. was absolutely dying, and could no longer hold the pen, but he either stamped Surrey's death-warrant himself or had it stamped in his presence. By the time Norfolk's death-warrant arrived the king was unconscious, and the duke was saved, but Surrey had been beheaded on Tower Hill, 21st January, 1547, a week before the king's death.

Surrey's poems passed in manuscript from hand to hand, delighting all lovers of language, for full ten years after his death before they appeared, forty in number, in Tottel's "Miscellany" (first edition, 1557). They contain some fine love-poems addressed to an imaginary mistress, after the fashion of the time. Surrey's mistress was called Geraldine, and was in fact a little child whom he greatly loved, Elizabeth, daughter of Gerald Fitzgerald, earl of Kildare, the ward of the Princess Mary, already a devout Catholic and a warm friend of the Howards. Lady Elizabeth Fitzgerald (Geraldine) was but nineteen when Surrey died, and she had been married already four years. She was ten or twelve when he began to address his verses to her. The usual fable about Surrey's Geraldine was a pure invention of Nash, the Elizabethan dramatist, who concocted an elaborate love story, long believed, but (as Surrey's own sonnets show) without a shred of truth to support it. Surrey's sonnets, though with more fire than his friend Wyatt's, are not so accurate in either form or rhythmical construction, if Petrarca's model is to be held the canon, as it surely should be. Shakespeare's sonnets, miracles of expression though they be, are yet further from the true form than Surrey's. In studying these newly perfected metres of the great Italians of the Renaissance, Surrey came against the poems in *versi sciolti* (free, *i.e.* unrhymed verses). Boccaccio and the great St. Francis are widely enough apart as authors, but both used these *versi sciolti*. They were printed as prose, and only betrayed themselves by the beautiful cadence they took on being recited. After a considerable time of desuetude this style was revived and perfected in the sixteenth century, and Ariosto gave it a splendour less brilliantly reflected by many lesser poets who surrounded and imitated him. Into this new metre, which we call blank verse, Surrey translated some books of Virgil's Æneid. One or two of his lines follow as an example:—

> "It was the time when, granted from the gods,
> The first sleep creeps, most sweet, on weary folk:
> Lo, in my dream, before mine eyes methought
> With rueful cheer I saw where Hector stood,
> Drawn at a car as he of late had been,
> Distained with bloody dust whose feet were bowln
> With the strait cords wherewith they haled him."
>
> (Bowln = swollen; strait = tightly drawn).

From this beginning sprang "Marlowe's mighty line," soon to be eclipsed by the matchless periods of Shakespeare, and in fine to culminate, a generation later, in the majesty and stately simplicity of Milton. Brought at once by Surrey to striking completeness, and carried on with such a mighty power, blank verse has become the great English medium for all that is epic, heroic, or sublime; one of the grandest, as it is one of the most various modes of poetical expression that the world possesses.

SURTR or **SURTUR,** the giant-spirit of the thick black smoke of conflagration in the Norse mythology. He himself was dark as night and moved in a mantle of dense cloud, but he wielded a flaming sword. He was one of the sons of Muspel, the gigantic opponents of the Ases or Gods; and Surtr and his brethren dwelt with their father in Muspelheim (Fire-home), all through the period of the first life, preparing themselves for the final battle of Ragnarök, when heaven and earth, gods and men, were to be overthrown by the giants and swallowed up by the monsters, the Wolf and the Snake. The god Freyer fell by Surtr's flaming sword at the same time as the jaws of the Fenris-Wolf closed on Father Wotan; and then amid the crash of worlds Surtr flung his fire-sword from him, and the whole universe was burnt up in the flame.

It was the faith of our ancestors that this flame, though all devouring, was all-purifying too; and that when the fatal sword had done its work a new heaven and a new earth, a purified race of gods, and a nobler race of men, rose out of the ashes.

SURVEYING is the art of measuring, and then representing on paper, the form and dimensions of parts of the earth's surface and of objects situated upon it. The term "surveying," when used in a comprehensive sense, includes levelling; but in a restricted sense, *surveying* is used to denote the art of ascertaining and representing the form of the ground and the relative positions of objects upon it, as projected on a horizontal surface; and *levelling,* to denote the art of ascertaining and representing the relative elevations of different parts of the ground.

The results of surveying, laid down on paper by the operations of "plotting" and drawing, constitute a *plan* or *ground plan;* those of levelling are usually laid down in the form of a *vertical section,* called more briefly a *section* (although there are other ways of representing them). A *plan* is a miniature representation of the ground and the objects upon it, and sometimes of a proposed engineering work, as projected on a horizontal surface, that surface being represented by the surface of the paper on which the plan is drawn. A plan differs from a map chiefly in the scale on which it is drawn, the scale of a plan being large enough to serve for the purchase and sale of land, or the designing of engineering works, while that of a map is so small as to make it serviceable for the purposes of travelling and geography only. The scale on which a plan is drawn means the proportion which distances, as represented on the plan, bear to the corresponding distances on the ground. Among continental European nations it is customary to express that proportion by means of a fraction, such as 1–10,000th. In Britain it is customary to refer to two units of length, a short unit for the paper, and a long unit for the ground. For example—*six inches to one mile* expresses the scale which, according to the continental system, would be called 1–10,560th.

The magnitude of the scale which is best suited for the plan of a particular survey varies according to the minuteness and complexity of the objects to be represented. For example, from 1–100,000th to 1–60,000th are scales suitable for maps to be used in exploring the country; from 1–16,000th to 1–10,000th for preliminary or parliamentary plans of engineering works; 1–2500th for detailed plans of such works in the country, and of landed estates; from 1–1000th to 1–500th for plans of towns and of works for their improvement, &c.

A *vertical section* shows the figure of a certain line or track on the natural surface of the ground, and sometimes that of a proposed work to be executed along that line, and sometimes also that of the internal strata, as projected on a vertical surface; that vertical surface being represented by the surface of the paper on which the section is drawn. A certain straight line on that paper, called the *datum-line,* represents a fixed horizontal surface at any convenient height above or depth below some fixed and known point, called the *datum-point.* Lines parallel to the datum-line represent in miniature distances measured horizontally along the line or track on the earth's surface to which the section relates. Lines perpendicular to the datum-line represent in miniature, heights above or depths below the datum horizontal surface. The natural surface of the ground, that of a proposed work, and those of internal strata, are represented by lines, straight, curved, or angular, which at each point are at the proper vertical distance from the datum-line.

Except in a few cases of rare occurrence, the *scale for horizontal distances* on a section is the same as the scale of the plan with which it corresponds. The *vertical scale,* or *scale for heights,* is almost always much greater than the horizontal scale, because the differences of elevation between points on the ground are in general much smaller than their distance apart, and require to be represented on a greater scale on paper, in order that they may be equally conspicuous to the eye; and also, because in the execution of engineering works accuracy in levels is of more importance than accurary in horizontal position, and vertical heights should be represented with greater precision than horizontal distances. The proportion in which the vertical scale is greater than the horizontal scale is called the *exaggeration* of the scale; and it ranges from 6 to 18 in ordinary cases. In preliminary sections of engineering works, a vertical scale of 1–1200th of the real dimensions is sufficient; in working sections, scales of from 1–500th to 1–250th are required, and sometimes even larger scales.

Vertical sections *without exaggeration,* showing the horizontal and vertical dimensions of the ground in their real proportions to each other, are required at the sites of proposed large works in masonry, timber, and iron, such as viaducts. These sections are in general drawn on a larger scale than the vertical scale of ordinary working sections.

Methods in Surveying.—There are two principal methods followed in surveying, each characterized by the elementary mathematical process which it involves; the *method of distances and offsets,* used for filling up the details of a survey; and the *method of triangles,* used chiefly for ascertaining the positions of certain principal points or *stations,* but occasionally applied to filling up the details also.

The method of *distances and offsets* may be illustrated as follows. In Plate 1, fig. 2, A is the representation on paper of a station, or fixed and marked point on the ground, and A B that of a station-line extending from A in a known direction to another station, B. Near the station-line, A B, there lies an irregularly-shaped boundary, whose figure is to be surveyed; in the present example it is the bank of a river, but it might be a road, a fence, &c. The surveyor starts from the station, A, and measures distances with the chain along it towards B. On arriving perpendicularly opposite a point where the direction of the river bank changes, he notes the distance from A, and measures the *offset,* or perpendicular distance of the object to be surveyed from the station line. The offsets are marked in the Plate by short dotted lines. Being laid down or "plotted" on the plan in their proper positions, and of their proper lengths, they enable the figure of the river bank to be drawn; and in the same manner the details of all objects on the ground are surveyed.

The method of *triangles* is as follows:—In the same Plate and figure, A and B, upon the paper, represent two stations or points on the ground, whose relative position—that is, their distance apart, and the direction of the line joining them—has been ascertained. It is required to ascertain and lay down on the paper the position of a third station, C, relatively to those two. This is to be done by measuring any two out of the following four quantities:—

the distances A C and B C:
the angles C A B and C B A,—

and plotting or laying down on the paper the representation either of the quantities actually measured, or of others calculated from them. The object of such calculation is in most cases to lay down the distances A C and B C on paper, when the angles at A and B have been measured on the ground; for on the ground angles are more easily measured with precision than distances; and on paper distances can be laid down more accurately than angles.

When a triangle has been surveyed by measuring the length of its three sides, a check on the accuracy of that measurment is obtained by measuring a *tie-line;* that is, a straight line crossing the triangle in any convenient position, such as *c f* in same figure. When the triangle has been surveyed by angular measurements, the accuracy of those measurements is checked by measuring all the three angles, when their sum should be equal to two right angles, if the triangle is sensibly plane.

In surveying by angular measurements, the branch of mathematics by which the necessary calculations are to be performed is that which relates to the figures and dimensions of triangles; that is, TRIGONOMETRY. When the triangle formed by three stations is of such extent that the curvature of the earth may be neglected, its sides are sensible straight lines, and the rules of plane trigonometry are to be used. When the curvature of the earth has a sensible effect, the sides of the triangle are to be

considered as being nearly arcs of circles, of a radius equal to that of the earth, and recourse must be had to spherical trigonometry. This, however, is of rare occurrence in surveys made expressly for purposes of agriculture or of engineering. The principles of spherical trigonometry are also occasionally required, when an angle has been measured on an inclined plane, to compute the corresponding angle as projected on a horizontal plane.

In great trigonometrical surveys, of such extent that the curvature of the earth affects sensibly the figures of the triangles, the sum of the three angles of a triangle, if correctly measured, should be greater than two right angles by a quantity called the *spherical excess*, which bears the same proportion to 360 degrees that the area of the triangle bears to half the earth's surface; that is to say, the spherical excess is one second for every 2,115,500,000 square feet of area of the triangle. In calculating the length of the sides of such triangles a sufficiently close approximation may in general be obtained by subtracting one-third of the spherical excess from each of the three angles, and then calculating the proportions borne by the sides to each other from those diminished angles, as if the triangle were plane.

In all surveying by the method of triangles care should be taken to avoid *ill conditioned triangles;* that is to say, triangles in which angles occur that are either very acute or very obtuse, say less than 30 degrees or greater than 150 degrees; for in such triangles small errors in the measurements, whether of sides or angles, produce comparatively great errors in the results.

Stations are to be chosen so as to be convenient spots at which to measure angles, or from which to measure distances; they should command a clear view of each other; and they should form with each other well-conditioned triangles. Hence they seldom coincide with existing objects on the ground, but have to be marked artificially. This is commonly done by means of wooden stakes driven into the ground, and in the case of important stations in a trigonometrical survey, by means of stone blocks with suitable marks on them. *Signals* are marks fixed at stations to make them visible from a distance; they are usually poles of greater or less size, according to the distance from which they are intended to be visible. Care should be taken to set them up in a truly vertical position. The stations of an ordinary land survey are marked thus ⊙ in Plate I., fig 2.

Instruments.—For measuring distances the ordinary instrument is the *chain*, consisting of 100 links, made of iron or steel wire, connected with each other by means of rings, and marked at every tenth link with peculiarly shaped pieces of brass. The length of the surveying chain commonly used in Britain is 66 feet, being one-eightieth part of a statute mile, so that a square chain is one-tenth part of an acre; but cha[illegible]s of 100 feet are used also, and are convenient in the setting out of engineering works. Along with the chain are used iron or steel pins called *arrows*, usually ten in number, to mark its ends on the ground, and to facilitate the counting of the number of chains in a given line. In order that distances may be accurately "chained," the length of the chain should be tested every morning before starting: the chain should be carefully stretched in an exact straight line from station to station; and where that line has an inclination the distance as measured on the slope should be reduced to its horizontal projection, being the distance on the level. This may be done either by multiplying by the cosine of the angle of inclination of the line chained, or by subtracting the square of the difference of level of the two ends of the line chained from the square of the distance on the slope, when the square root of the remainder will be the distance on the level. For measuring with great exactness the base-lines of trigonometrical surveys steel chains of special accuracy are used, which are supported in a truly level position, and kept at a uniform tension, and have their temperature measured by the thermometer, in order that the effect of heat upon the length may be allowed for. Metallic rods are also used for the same purpose.

For measuring short distances in a detailed survey the *tape-line* and *offset-staff* are used. The tape-line should be strongly woven of the best and toughest flax. The offset-staff is a light wooden rod tipped with metal; it is ten links long, and is divided into links. The *cross-staff* and the *optical square* are instruments used for setting out offsets truly perpendicular to a station-line.

For measuring angles the usual instrument is the *theodolite*, of which there are many forms. One of the most common is shown in Plate II. C is the vertical axis, supported on a three-legged wooden stand, with which it is connected at D by a ball-and-socket joint; F and G, the parallel plates, the lower connected with the stand and the upper with the vertical axis; *b b b*, the plate screws, four in number (one concealed), serving to set the vertical axis truly vertical. The vertical axis consists of a tube or hollow cylinder, containing a spindle which fits it accurately; these can be turned about independently of each other. H is a clamp screw for grasping and fixing the tubular vertical axis by means of the collar *c*; I, a slow-moving screw for precisely adjusting its position. The tubular axis carries the horizontal circle, B, which is divided into 360 degrees, and further subdivided according to the size of the instrument. The internal spindle of the vertical axis carries the vernier-plate, A, which has two, and sometimes three, verniers or graduated indexes for indicating angles on the graduated limb of the horizontal circle; one of these is shown at *a*. E is a microscope for magnifying the divisions of the circle and verniers. The vernier-plate, like the horizontal circle, has a clamp screw and a slow-moving screw for adjusting its position; but in the figure these are hidden. Two spirit-levels, *d d*, serve to show whether the vertical axis is truly vertical. J is a magnetic compass fixed on the vernier-plate. K and L are the standards supporting the transverse axis O, which carries the telescope, Q. A third spirit-level, *f g*, is attached to the telescope tube, and is employed when the theodolite is used for taking levels, or for measuring angles of elevation or depression by the help of the vertical circle M. P is the slow-moving screw, and N the microscope of the vertical circle. At the common focus of the object-glass and eye-glass, near the point marked *j*, the telescope tube contains a diaphragm or partition, in the centre of which is a hole, crossed usually by three very fine wires, one horizontal, and the other two deviating slightly from the vertical in opposite directions, like the limbs of the letter X. The point of intersection of those three wires marks the *line of collimation*, or longitudinal axis of the telescope. This line is adjusted so as to be always exactly perpendicular to the transverse axis O, which is adjusted so as to be exactly perpendicular to the vertical axis; so that when the vertical axis is truly vertical the transverse axis is truly horizontal, and the line of collimation turns about the transverse axis in a truly vertical plane. To measure with the theodolite a horizontal angle, such as B A C in Plate I. fig. 2; having planted suitable poles at B and C, set up the theodolite with its vertical axis exactly above the mark at the station A (by the aid of a plummet), and adjust that axis to a truly vertical position. Look through the telescope and point the line of collimation towards B, making the intersection of the cross-wires cover the pole. Read off the graduations of the horizontal circle at the verniers, and take the mean of the readings. Perform the same operation with the line of collimation pointed towards C. The difference between the mean angles read off in these two positions of the telescope will be the required angle, B A C. As a safeguard against large blunders in

reading off whole degrees, the magnetic bearings of the objects B and C may be read on the compass, and their difference taken.

Theodolites for ordinary purposes are made with the horizontal circle from 4 to 6 inches in diameter. Where special accuracy is required the diameter of that circle ranges from 8 inches to 3 feet.

Instruments such as the *sextant*, for measuring angles by reflection, are sometimes used in surveying, especially in marine surveying.

The *plane table*, which is occasionally employed for surveying ground, is a square board fitted upon a tripod stand and furnished with a compass, and with an *alidade* or ruler, carrying sights at the extremities. Drawing paper is made fast to the board or table, and the instrument being set up at any part of the ground which may be thought convenient, a point is marked on the paper to represent the station. The alidade is next turned about that point, so that the line of the sights may be directed to any remarkable objects whose situations are to be determined, and lines are drawn by the edge of the ruler in its several positions; then the distance from the instrument to some one of those objects being measured, and laid down on its line of direction by a convenient scale, the place of that object on the paper is obtained. The table is then removed to that object, and fixed so that its edges may be parallel to their former positions; that is, till the alidade placed on the line joining the places of the two objects on the paper is in a direction pointing to the former place of the instrument. In this position, the alidade being turned about the point which represents the actual place of the instrument on the ground, lines are drawn as before along the edge of the ruler, towards the several objects which had been observed at the preceding station: the intersections of those lines with the others determine the places of the objects on the paper.

In *plotting* a survey on paper distances are laid down by the help of *scales* of ivory, metal, boxwood, or paper, and of *compasses;* and angles by means of *protractors.*

The principal *classes of surveys* are two, the trigonometrical and the topographical.

A *trigonometrical survey* consists in covering a whole country with a network of triangles, having their angles at permanently marked stations in commanding positions; and its objects are, to determine the dimensions and figure of the earth, and to determine the positions of stations to be afterwards used in surveys of a more detailed kind. Part of the triangulation of the ordnance trigonometrical survey of Britain, including the triangles which connect it with that of France, is shown in Plate II. The triangles are numbered in the order in which their dimensions were calculated. In a survey of this class only one or two straight and level lines, called *base-lines*, are measured with extraordinary accuracy: they are from 3 to 5 miles long. The remainder of the survey is carried out wholly by the measurement of the angles and the calculation of the sides of a network of triangles, whose sides range from the length of the base up to 100 miles. The most powerful and accurate instruments are employed, and every observation and result carefully checked. The latitudes of the most important stations are found by astronomical observations, and sometimes also their longitudes.

The purpose of a *topographical survey* is to represent the ground and the objects upon it on paper, in greater or less detail. Scales suitable for different degrees of detail have already been mentioned. When a topographical survey forms part of a general survey of a whole country, it is based upon the general triangulation of the trigonometrical survey, and it proceeds by choosing subordinate stations, so as to subdivide the great triangles of the trigonometrical survey into smaller triangles, and those into smaller still, until a network of station-lines is obtained running so near to the streams, roads, fences, buildings, and other objects, that these can be surveyed in detail by means of offsets. It is in all cases favourable to accuracy that a topographical survey should thus be based on a trigonometrical survey; but it is not always necessary; and a topographical survey may be based on a triangulation of its own, care being taken to make the principal triangles as large as possible. For example, in Plate I., fig. 2, is represented part of a topographical survey, laid down on a scale of 12 inches to a mile, or 440 feet to an inch, or 1-5280th of the natural dimensions. The capital letters A, B, and C, represent three principal stations, forming a large or comparatively large triangle; and that triangle has been surveyed either by measuring the three sides with the chain, or by measuring one side and two of the angles, or what is better, all three angles. Subordinate stations are chosen at points, some of which are marked with small letters; so that the network of station-lines lies near the objects which are to be surveyed in detail. To survey the boundaries of a piece of ground that cannot be seen across, such as a wood, a triangle is laid out surrounding it, such as D *a* H, and, if necessary, subordinate station-lines are chained in connection with that triangle, as *a* G, G F, F E, so as to enable offsets to be measured to the boundary. The directions of those subordinate lines are found by measuring the angles which they make with an object, such as H, situated at an angle of the triangle *a* H D.

A topographical survey may embrace the finding of the levels of the ground. The principles of the construction and use of the levelling instrument have been described under the head SPIRIT LEVEL; and the explanation given of the process of taking levels will enable the section shown in Plate I., fig. 1, to be understood. In that section the datum-line, already referred to, is above part of the ground represented, and below another part; but it is more convenient to choose a datum line at so low a level as to be below every part of the ground to be shown. For showing the levels of a proposed engineering work, and of the ground where it is to be made, a continuous vertical section is always employed; but for many purposes it is convenient also to mark the levels of important points in figures on the plan, and also to show the form of the surface of the ground by *contour-lines.* A contour line is a line passing through all the points on the ground which are at a given level (for example, 50 feet, 100 feet, 150 feet, &c., above the mean level of the sea). The old form of levelling staff, with a sliding vane, and three varieties of the latter form, with scales that can be read through the telescope, are also shown on the Plate.

The subject of topographical surveying may be further subdivided, according to the special purpose of the survey. In an *engineering survey*, for example, the proposed work is very often a line of communication, such as a road, a railway, or a water channel. and the survey embraces a long narrow band of country. Here it is favourable to accuracy to have long station-lines stretching as far as possible longitudinally through the tract to be surveyed. The detailed survey is preceded by an exploration of the country, and by the taking of trial levels, to find the best line for the proposed work; and the detailed section is often accompanied by the results of trial pits and borings, made to ascertain the strata in which the work is to be executed. If the proposed work is one of drainage or water-supply the survey embraces the gauging of rainfall and of the flow of water in streams. In a *marine* or *hydrographical survey*, many of the stations are points on the water, whose positions are determined by means of angles measured with the sextant by observers in boats. The levels of the bottom are taken by sounding, in connection with observations of the rise and fall of the tides. The materials of the bottom also are ascertained, whether with a view to its qualities as mooring ground, or as a

foundation for harbour works; and the direction and speed of currents, and the direction, size, and force of the prevailing waves, are observed and recorded. In a *geological survey* the positions of geological formations are observed on the ground and shown in colours on a map, and sometimes also on vertical sections of the country. In a *mining survey* the measurement of distances and angles goes on underground, by means of lamps and of instruments specially suited to underground work.

SURVI'VORSHIP. A question of life contingencies is said to be one of survivorship when a benefit depends upon the order of the deaths of individuals in such manner that it shall be necessary to calculate the chance of one individual dying before another in every year of life. This distinctive name depends therefore entirely upon the mathematical character of the problem; and of two questions which both seem to depend on survivorship in the common sense of the word, one may really do so, in the technical sense, and not the other. Thus the question of finding the premium of an assurance on the death of A, provided B die first, is one of survivorship; but that of finding the value of an annuity on the life of A, to begin at the death of B, is not.

The *chance of survivorship* is that of one individual, now of a given age, surviving another, also now of a given age. Thus, according to the Carlisle Table, the chance that a person aged sixty-five will survive one aged twenty-five is ·110; consequently the chance of twenty-five surviving sixty-five is 1 — ·110 or ·890; and it is 890 to 110, or about eight to one, that of two persons aged sixty-five and twenty-five, the elder shall die first.

SU'SA, a town of Northern Italy, 31 miles west of Turin by railway, has a Gothic cathedral, and a chapel on a steep height 11,000 feet above the sea, to which a procession is made annually. Two roads across the Alps meet here, and in 1868 a line of railway from Susa to St. Michael, over Mont Cenis, was opened, thus affording unbroken communication between Turin and the whole of Western Europe. Another line was at the same time being made under the mountain, and when that was completed the summit railway was no longer used. There are iron mines and marble quarries near the town.

SU'SA or **SHUSAN** represents generally the *Susiana* of antiquity, which comprised within its limits Susa, the "Shusan" of the books of Esther and Daniel, one of the old royal residences of the Persian kings, and chosen as their winter abode in consequence of the warmth of its climate. The city is said to have received its name from the abundance of the lily (*Shusan* or *Shushanan*) in its neighbourhood. Most historians and comparative geographers have inclined to identify it with the modern Sus or Shush, in the province of Khuzistan, which is in 32° 10′ N. lat., and 48° 26′ E. lon., between the Shapur and Dizful. At the distance of a few miles ea and west of the city were two other streams—the Copr.tes or river of Dizful, and the right arm of the Choaspes, the modern Kerkah. The latter river was formerly so celebrated for the excellence of its water that the Persian monarchs generally carried a sufficient supply of it with them when journeying, so that recourse might not be had to any other. Hence Milton's reference—

> "There Susa, by Choaspes' amber stream,
> The drink of none but kings."

The ruins of Susa cover a space of about 6000 feet long from east to west, by 4500 feet broad from north to south. The circumference of the whole, exclusive of outlying and comparatively insignificant mounds, is about 3 miles. The principal existing remains consist of "four spacious artificial platforms, distinctly separate from each other. Of these the western mound is the smallest in superficial extent, but considerably the most lofty and important. Its highest point is 119 feet above the level of the Shapur. In form it is an irregular obtuse-angled triangle, with its corners rounded off and its base facing nearly due east." Mr. Loftus regarded this mound as indubitably the remains of the famous citadel of Susa, so frequently mentioned by the ancient writers, and his conclusions have been confirmed by the explorations of M. Dieulafoy in 1885, described in his interesting work "L'Art Ancien de la Perse." The entire vicinity is now a wilderness, and lions, hyenas, and jackals haunt the tall reeds by the side of the rivers, but the natural herbage of the district is very fine, and the plain is covered with a carpet of the richest verdure.

Susa was recognized as the capital of the Persian Empire until the Macedonian conquest, after which the preference of Alexander for Babylon caused it to be neglected.

SU'SA or **SOUSA,** a seaport town of Barbery, in the government and 67 miles S.S.E. of Tunis, situated partly on a hill, partly on the shores of a large but unsafe roadstead; its walls, gates, and ramparts are in good preservation, several buildings have an imposing appearance, and its trade is considerable, chiefly with Italy. The population is about 8000, including 1000 Jews, and 500 to 600 Maltese and Sicilians.

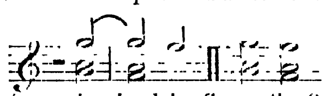
SUSAN'NAH, THE HISTORY OF, called also *Susannah and the Elders* and *The Judgment of Daniel*, an addition to the Book of Daniel found in the Septuagint, the Old Latin version, and included in the Vulgate and the existing Syrian and Arabic versions of the Old Testament scriptures. It appears, however, to have been originally wanting in the Syriac version, and there is no evidence to show that it ever formed part of the Hebrew text, hence the book is placed by Protestants in the Apocrypha. In the Old Latin version it is placed at the beginning of the Book of Daniel, but in the Septuagint and the Vulgate it is placed at the end, and reckoned as the thirteenth chapter. The origin of the story is unknown, but it is not improbable that an Alexandrine translator of the Old Testament utilized a current tradition for a moral purpose, and appended it to the Hebrew book. The story relates the temptation of Susannah, the beautiful wife of Hilkiah, by two elders, the false accusation of adultery laid against her by them, and the subsequent frustration of their conspiracy by the wisdom of Daniel. The design of the story appears to be to celebrate the triumph of chastity over temptation, but some commentators, both ancient and modern, have given it an allegorical interpretation.

SUSPENDING POWER, the right claimed by many of our kings to suspend the operation of any statute. Not unfrequently a proclamation or grant would be issued "notwithstanding any law to the contrary." The first monarch to use the suspending power was Henry III., who thereby sought to evade the provisions of Magna Carta and the subsequent charters. Edward I. carried the practice further, and notably, in 1307, suspended the entire statute of Carlisle. Richard II. was a frequent offender. Under the House of Lancaster, with its strict parliamentary usages, the suspending power was rarely if ever used; but the Yorkists, reigning in times of a weakened baronage, could defy Parliament to a large extent. Their successors, the Tudors and Stuarts, held high doctrines on the point, and under the latter a steady parliamentary opposition to the practice grew up. The great Civil War raised Parliament to supreme power, and when, therefore, after the Restoration, Charles II. suspended no less than forty statutes in his Declaration of Indulgence (1672), chiefly designed for the relief of Roman Catholics, Parliament declared that the king had no right to suspend Acts of Parliament, and eventually the declaration was withdrawn. James II. reissued it in 1687 in a still stronger form, and it was one of the main causes of his downfall. The suspending power was expressly denied and prohibited in the Bill of Rights (1689), which destroyed whatever of assumed right it might have acquired.

SUSPENSE ACCOUNT is the name given to a private account opened in the ledger of a merchant or a company to contain unsettled matters which cannot be placed to proper accounts. It has both a credit and a debit side, for on the one hand moneys may arrive without its being quite certain where they ought to be credited, and on the other hand charges may arise which, from some momentary irregularity, or from death, or dispute, &c., cannot at the time be debited to any particular account. As soon as the destination of any of these items is discovered they are transferred to their proper place from the suspense account.

SUSPEN'SION, in music. A note is suspended when it is retained from a chord of which it has formed part, while another chord is sounded of which it does not form part; and the suspended note thus takes the place of one note of this second chord, proceeding eventually to the note which it has supplanted by what is called its resolution.

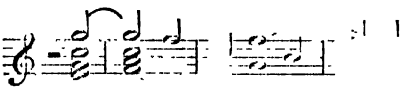
What occurs, in fact, is that one part of the music has moved slower than the remaining parts: and this view of suspensions at once corrects the usual faults of beginners. For it is evident that no newly-sounded note can be a suspension, and to sound a note in one part and venture on the strength of this to sound it in another part against a fresh chord as a suspension is precisely equivalent to sounding an unprepared discord. In every case the suspension must be held on in the same part where it was first sounded. The second rule is that (except the suspended Ninth) a suspension and its resolution may not be sounded together. The third rule is that no progressions will stand because of the suspension which would be faulty if all the parts had moved together. The following example is therefore to be held as faulty by consecutive octaves, just as much as if the suspension did not cloud the fault.



Faulty Suspensions involving Consecutive Octaves.

The suspended Ninth is resolved upon the Octave (root), the suspended Fourth upon the Third; and if the two occur as a double suspension their resolution is the same as in the separate cases.

A B C



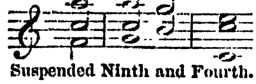
Examples of Suspension.

At A, the treble contains g'' as a suspended Ninth against the chord of F, and the resolution is upon the octave, *i.e.* the root. This is the only case when a suspension and its resolution are lawfully heard together. At B, in the middle part the c'' is continued against the dominant Seventh on g' as a suspended Fourth, resolving on the Third of the chord. At C the resolution of the Seventh is delayed, so that it becomes a suspended Fourth, and falls to its resolution on the Third.

A string of suspensions often occurs by sequence, as thus:—

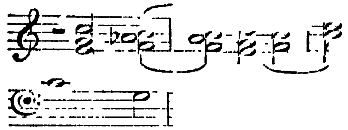
Sequence of Suspensions.

Finally, we may have double suspensions and suspensions of complete chords, as thus:—



Suspended Ninth and Fourth.

The suspension of complete chords is rarely possible except where the bass moves by the rise of a Fourth.



Suspension of Complete Chords.

SUSPEN'SION BRIDGE, a bridge in which the weight of the structure with its load, instead of resting upon arches, or girders, or a rigid framework, is supported by the tension of chains or of cables; now always made of iron or steel.

Suspension bridges possess advantages over rigid structures in point of economy of material, and of the greatness of the span which they are capable of crossing, for the following reasons:—When a loaded chain or cable in a state of tension is displaced from its proper position and figure by any disturbing force, it tends to return to that position and figure. When an arch, a pillar, or any piece in a frame that is in a state of compression is displaced from its proper position and figure, it tends to become displaced and disfigured more and more, and finally to break, unless it is sufficiently stayed and stiffened. Hence a structure like a suspension bridge, whose principal parts are in a state of tension, requires little more material than is necessary for strength to resist the direct action of the load; while a structure like an arch, or a trussed frame, in which either all or many of the principal parts are in a state of compression, requires a quantity of additional material to give stiffness. That additional material involves additional weight, and thus limits greatly the utmost practicable span, by causing that span to be sooner reached at which the bridge is just able to bear its own weight and no more.

On the other hand, suspension bridges, owing to their flexibility, have the disadvantage of being liable to be thrown into a state of violent oscillation, and thus overstrained or broken, by a load that either exerts a series of impulses at regular intervals, like a body of soldiers on the march, or moves with great speed, like a railway train. This evil, however, can to a certain extent be averted by a method of partial stiffening by means of framework, care being taken not to increase the weight too much.

Suspension bridges are by no means of recent origin. The Chinese chain bridges, and the rope bridges of Bootan and of South America, are examples. Rope bridges have long been used in military operations in Europe. Sir Howard Douglas, in his "Essay on the Principles and Construction of Military Bridges," describes several of them. One of the most interesting applications of ropework in the form of a bridge was made in 1812, at the passage of the Tagus by the British army. The object was to provide a passage over Trajan's Bridge at Alcantara, one of the arches of which had been destroyed by the French. The gap was nearly 100 feet wide and 140 deep; and over this a network of ropes and timber, which had been prepared, was stretched, its extremities being made fast to the remaining masonry of the piers.

We have no account of the existence of iron suspension bridges in Europe before the middle of the eighteenth century. The earliest appears to have been a small one built across the river Tees, at an elevation of about 60 feet, 2 miles above Middleton, for foot-passengers only. The first built in America was that constructed in 1796, by Mr. Finlay, across Jacob's Creek, on the road between Union Town and Greenburgh, the length of which was about 70 feet. Mr. Finlay subsequently, in 1801, obtained a patent for the construction of such bridges, and built several in the United States; one of which, over the Schuylkill, was 306 feet long. In 1816 a suspension bridge was built

across the Gala Water, made of thin wires, at a cost of only about £40, although its span was 111 feet. Another wire bridge of about the same length was built in 1817, across the Tweed, at King's Meadows, at an expense of £160. The platform was 4 feet wide, and was sustained by wires radiating from the tops of two cast-iron columns at each end of the bridge. Sir Samuel Brown soon afterwards introduced an improved method of constructing chains for suspending the roadway. It consisted in forming chains of round or flat bars of iron, several feet long, having eyes at each end, and being connected together by short links and bolt-pins. The first extensive bridge erected upon this plan was the Union Bridge across the Tweed, near Berwick, opened for use in 1820. The span is 449 feet, and the deflection is about 30 feet. In 1821 Brown commenced the Trinity suspension pier at Newhaven, near Edinburgh, which consists of three spans of 209 feet each, with 14 feet deflection. In 1818 the Holyhead Road Commissioners applied to Telford for his opinion respecting the erection of an iron suspension bridge at the Menai. A brief account of this beautiful bridge will be found under MENAI STRAIT.

The following table, abridged from Rankine's "Manual of Civil Engineering," gives the principal dimensions of some suspension bridges:—

Bridge, Structure, and Engineer.	Span of	Depression of Complete Spans.	No. of Chains or Cables	Breadth of Platform over all.
		Feet.		Feet.
Union (round rods), . (Brown.)	449	30	6	18
Menai (flat links), . . (Telford.)	570	43	16	28
Chelsea (flat links), . (Page.)	183 348 183	29	4	
Clifton (flat links), . (Brunel & Barlow.)	702·2[illegible]	70	6	31
Pesth (flat links), . . (Tierney Clark.)	298 666 298	47·6	4	46
Bamberg (flat links), .	211	14·14	4	30·5
Freiburg (wire), . . (Chaley.)	870	63	4	21·25
Kieff (flat links), . (Vignoles.)	220 400 400 400 400 220	—	4	52·5
Niagara Falls (wire), (Rœbling),	821·3	inner cables 5·4 outer cab 6·4		24
Niagara (wire), . . (Serrel.)	1040		10	30·5

Some suspension bridges have been erected in which the main chains, instead of passing over a pier or tower at or near each end of the platform, are supported by a single tower in the centre of the bridge, and form what may be called two semi-catenaries. A bridge of this kind was built in 1823 by Sir M. I. Brunel, in the Isle of Réunion. The bridge consists of two openings of 122 feet each; and to resist the strain occasioned by hurricanes, which often blow upwards as well as sideways, a set of chains is added under each half of the bridge, in the form of an inverted catenary. Another peculiarity in these bridges is the circumstance that the chains do not rest upon saddles or rollers in the suspension towers, but are suspended by links from a strong framework of cast-iron, by which means very free motion is allowed to the extent necessary to allow for changes of temperature.

The Clifton bridge, which crosses the Avon, near Bristol, is remarkable for the great height of its roadway above the river, 240 feet. It was opened for traffic in 1864. The Niagara Falls bridge is remarkable as having two platforms, one above the other; the upper for a railway, the lower for a road. They are diagonally braced together, in order to stiffen the bridge; nevertheless it is thought advisable to moderate the speed of railway trains in passing over it.

On the Continent the finest examples of suspension bridges are at Buda-Pesth, over the Danube, 666 feet span in the centre arch; and at Freiburg, in Switzerland, 870 feet in span.

The largest bridge yet built on the suspension principle is that between New York and Brooklyn, which occupied twenty-two years in construction, and was completed in 1883. It is described and illustrated in the article BRIDGE, Vol. III.

The following is an outline of the mechanical principles upon which the designing of suspension bridges depends. The proportion of the depression or deflection to the span must be fixed; it is seldom more than *one-tenth* nor less than *one-fifteenth*. Multiply the greatest load, including the weight of the bridge itself, by the span, and divide by four times the depression; the quotient will be the *horizontal tension*. To the square of the horizontal tension add the square of *half* the proof load; the square root of the sum will be *the tension at the points of suspension*. Then the effective sectional area of the cables or chains should be so calculated that the tension shall not exceed the following intensity:—For charcoal-iron wire cables, 15,000 lbs. on the square inch; for chains made of links of cable-iron, 10,000 lbs. on the square inch. The chains or cables hang in the form of a curve of the class called the "catenary;" but for practical purposes the parabola is a near enough approximation to the true form.

The platform is supported by cross beams of iron or wood, which are hung by means of suspending rods from the chains; and care is taken to distribute the load as equally as possible among the several chains. At the tops of the piers, the chains are supported either by cast-iron saddles or by rollers on a platform, so that they are free to move longitudinally. The *back-chains* are continuations of the main-chains from the tops of the piers to the ground, where they are anchored either to natural rocks, or to a mass of masonry of weight and dimensions sufficient to resist their tension. The position of the main-chains and back-chains should be such that the pressure on the tops of the piers may act vertically downwards, so as not to tend to overset them. When a suspension bridge is stiffened by means of a pair of auxiliary girders, those girders ought together to have that amount of strength which would enable them to bear safely *one-eighth* of the travelling part of the load.

SUSPENSION, ECCLESIASTICAL, is a mode of censure or secondary punishment inflicted by the church on persons guilty of those minor offences which do not deserve the severer penalties of deprivation or excommunication. "In the laws of the church," says Bishop Gibson, "we read of two sorts of suspension—one relating solely to the clergy, the other extending also to the laity."

"That which relates solely to the clergy is suspension *ab officio et beneficio* (*i.e.* the duties and income of his office) jointly, or *ab officio* or *beneficio* singly, and may be called a temporary degradation or deprivation, or both." "The other, which relates to the laity also, is suspension *ab ingressu ecclesiæ* (*i.e.* from entering the church) or from the hearing of divine service and receiving the holy sacra-

ment, which may therefore be called a *temporary excommunication*."* He also observes that the two sorts of suspension agree in this, that both are inflicted for crimes of an *inferior* nature; that both, in *practice* at least, are temporary; and lastly, both, if unduly performed, are attended with further penalties.

SUSQUEHAN'NA, a river of the United States, rises in the north-west part of the state of New York, and flows with a general south-east course through Pennsylvania to Chesapeake Bay at Havre de Grace in Maryland. Its total length is about 450 miles, but in consequence of rapids at the primitive ledge it is only navigable for about 5 miles from its mouth at the head of the bay.

SUS'SEX, a maritime county in the south of England, is bounded on the N. by Surrey and Kent, on the S. by the English Channel, E. by Kent, and W. by Hampshire. Its greatest length, from east to west, is 73 miles, and its extreme width, from Tunbridge Wells to Beachy Head, 27 miles. It occupies an area of 1456 square miles, or 931,006 acres. Its population, according to the census of 1881, was 490,316.

General Aspect, Soil, Geology.—Sussex has been divided by nature into four distinct districts, each with its local peculiarities of scenery and soil. These are the Weald or wooded country, extending in a long line from the hills beyond Petworth to the coast at Pevensey; the South Downs, which stretch from Beachy Head to the Hampshire border, a distance of 53 miles; the Hastings Sand division in East Sussex, which rises about the centre to a considerable elevation, called the Forest Ridge; and the Littoral or coast district, a rich and fertile level bordering on the Channel, and bounded towards the north by the grassy slopes of the Downs. It varies from 2 to 7 miles in breadth, and extends along the coast from Brighton to the confines of Hampshire. In the south-east of the county, touching upon Kent, lies a tract of productive marsh-land, about 30,000 acres in extent, and celebrated for the admirable pasturage it affords. The Weald, formerly covered with dense and almost impenetrable forests, includes 425,000 acres; a large portion still remains uncultivated. The soil is similar to that of the Weald of Kent, being for the most part a stiff tenacious clay, with occasional sandy and gravelly patches intermixed. It is still thickly covered with wood, principally oak, and when viewed from the Downs appears like an immense forest. Crowborough, in the Weald, is 804 feet high, and Fairlight Down, at its east end, is 600 feet, with a tract of marsh beyond it. The South Downs have an average elevation of 600 feet, the highest points being File Beacon, 820 feet, and Chanctonbury Ring, 814 feet. A strip of greensand on the north of this ridge is 858 feet high at Ditchling Beacon. The soil is generally a light marly mould, on a substratum of loose chalk. There are about 150,000 acres of Downs land, clothed with a fine, short, crisp herbage, which nourishes the famous breed of Southdown sheep. The valleys among the hills are usually fertile, so that an excellent field is furnished for mixed husbandry. By pasturing the sheep on the hills during the day, and folding them on the arable fields at night, the latter are highly fertilized. The arable land of the county occupies about 300,000 acres, and between 130,000 and 140,000 acres are covered with forest, as Ashdown Forest (18,000 acres) and St. Leonard's Forest (10,000 acres).

The principal geological divisions correspond with those already mentioned. Between the chalk formations of the North and South Downs, the former of which great ranges traverses Hampshire, Surrey, and Kent, lies the valley of the Weald, composed of four distinct formations; first, at the foot of the chalk and encircling the whole valley, a narrow band of gault; next, a belt of lower greensand, with a group of ferruginous sand and sandstone, clay, chert, and silicious limestone; third, an inner ring of Weald clay; and lastly, in the centre of the valley, an elevated ridge of Hastings sand, composed chiefly of sand, sandstone, clay, and calcareous grit. Each of these four belts or rings terminates abruptly toward the sea, like the chalk itself.

To account for the interposition of the Weald valley between the two great ranges of chalk downs Sir Charles Lyell supposes that the chalk remained undisturbed and in horizontal stratification until after the commencement of the Eocene period. When at length it was upheaved and exposed to the action of the waves and currents, it was rent and shattered, so that the subjacent secondary strata were soon after exposed to denudation. The waste of all these rocks, composed chiefly of sandstone and clay, supplied materials for the tertiary sands and clays, while the chalk was the source of flinty shingle and of the calcareous matter which we find intermixed with the Eocene clays. The tracts lying between the North and South Downs were first elevated, and, by their gradual decay, contributed to the production of the newer strata. These last were accumulated in deep submarine hollows, formed probably by the subsidence of certain parts of the chalk, which sank while the adjoining tracts were rising. Sir Charles Lyell thus explains the gradual elevation of the strata: "Supposing the line of the most violent movements to have coincided with what is now the central ridge of the Weald Valley, in that case the first land which emerged must have been situated where the Forest Ridge is now placed. Here a number of reefs may have existed, and islands of chalk, which may have been gradually devoured by the ocean in the same manner as Heligoland and other European isles have diminished in extent in modern times."

The ridge or dome first elevated would in time be so rent and broken as to afford numerous openings to the waves, whose ceaseless action, after a while, would remove the shattered masses. Then, on each side of a channel, as is now the case with France and England, would remain two strips of land, composed of chalk, with ranges of white cliffs confronting each other. A powerful current, like that of the Straits of Dover, might next pour through the hollow, and scoop out a deep channel in the gault. We must bear in mind that the intermittent action of earthquakes would accompany the denuding process, fissuring rocks, throwing down cliffs, and bringing up, from time to time, new stratified masses, and thus greatly accelerating the rate of waste. If the lower bed of chalk on one side of the Channel should be harder than on the other, it would cause an under terrace resembling that presented by the upper greensand in parts of Sussex and Hampshire. When at length the gault was entirely swept away from the central parts of the Channel, the lower greensand would be laid bare, and portions of it would become land during the continuance of the upheaving earthquakes. Meanwhile, the chalk cliffs would recede further from one another, whereby four parallel strips of land, or perhaps rows of islands, would be caused. From many points the present face of the Downs exhibits the exact likeness of a rocky coast. "Even those who are not accustomed to speculate on the former changes which the surface has undergone may fancy the broad and level plain to resemble the flat sands which were laid dry by the receding tide, and the different projecting masses of chalk to be the headlands of a coast which separated the different bays from each other."

They offer landscapes of surpassing beauty; broad sweeps of verdure unbroken save by *coombes* and *denes*, hollows, that is, where the oak, the hazel, the elm, and the ash nestle round some gray old church tower, some quaint manorial mansion, or some quiet farm. Here and there the smooth odorous sward is dotted with clumps of hawthorn and patches of bright green box; everywhere it blooms with orchises and gentians, and is carpeted with the softest and greenest moss. From the crest views of great extent and supreme loveliness extend on either hand; the rich

littoral plain, the long line of coast, with its busy towns and harbours and the broad bright waters of the Channel on the *one* hand, and the varied expanse of the Weald on the other, exhibiting a fine panorama of village, meadow, grove, orchard, and cornfield.

Hydrography and Communications.—The rivers of Sussex are the Medway, flowing northwards into Kent; the Rother, the Cuckmere, the West Rother, the Ouse, the Adur, and the Arun, flowing southwards into the English Channel.

The Ouse is formed a few miles north of Cuckfield by the junction of two streams, and flowing east and then south, passes by Lewes to the English Channel at Newhaven, where it is called Newhaven Harbour: its former outlet at Seaford is closed. The river is navigable for large barges 12 miles from its mouth without the aid of locks, and with them as far as Lindfield.

The Rother rises near Rotherfield, and passing by Mayfield flows east towards Kent. It then turns south, and passing by Rye forms Rye Harbour, falling into the sea by an estuary. It is navigable as far as the point where it just touches the borders of Kent above Newenden. This river formerly emptied itself into the sea at New Romney in Kent, 12 miles east of its present exit; but in the great storm of 1st October, 1250, which overwhelmed Old Winchelsea, and during the accompanying inundation of the sea it forsook its ancient channel and formed the new one to Rye. Several affluents join the Rother, which for a considerable part of its course forms the boundary between Sussex and Kent. In the year 893 a Danish fleet of 330 sail, under the command of the pirate Hastings, assembled near Boulogne, and directed its course to the English shores. Most of the vessels entered the Rother, then called the Limene. In 1822 one of these Danish barks was discovered embedded in 10 feet of mud and sand in a field at Northiam, a short distance from the present river, and about 2 miles from Newenden. The ship was in a perfectly sound and entire state after a lapse of 929 years. Her dimensions were from head to stern 65 feet, and her width 14 feet, with cabin and forecastle; and she appeared to have originally had a whole deck. She was very strongly built.

The Adur has two main sources, one of which flows south-east past West Grinstead, and the other south-west through Twineham and Shermanbury. The streams unite about 4 miles north from Bramber, and then flowing south the Adur falls into the sea at New Shoreham, where its mouth is protected by ingenious works.

The Arun rises in St. Leonard's Forest, and flowing west and then south, receives the Western Rother between Stopham and Pulborough. It then strikes south past Arundel to the sea at Littlehampton. The tide flows nearly 17 miles up the river, but the backwater is of little value in consequence of th narrowness of the channel and the sluggishness of the stream. The larger vessels which enter usually remain near the river's mouth at Littlehampton, but a ship drawing 13 feet of water can ascend to Arundel Bridge, a distance of 6 miles.

The Cuckmere rises in the Forest Ridge near Heathfield, and taking a southerly course, breaks through the South Downs and pours its waters into the Channel west of Beachy Head.

The Levant, a stream of small importance, encircles the city of Chichester on all sides but the north, falls into Chichester Harbour, and enters the sea at the extreme north-western point of the county.

The Medway rises at Turner's Hill, west of the church of East Grinstead, and then proceeds through Forest Row northward, to cross the borders between Groombridge and Ashurst, and traverse Kent on her way to the Thames below Chatham.

The Arun and Wey Junction Canal connects the two rivers after which it is named, and thus effects a direct water communication between London and the English Channel. The Arundel and Portsmouth Canal enters the Arun at Ford, and connects it with Portsmouth Harbour, and an artificial channel of the Rother provides a navigable water-way from Stopham Bridge to Midhurst.

Climate.—In the southern districts of Sussex, near the sea-coast, the climate is usually mild, and distinguished by a remarkable equability of temperature, the annual mean being 51° 10′, or upwards of one degree above that of London. The air of Hastings, Worthing, and Bognor is considered eminently favourable for invalids suffering from pulmonary complaints. At Brighton the atmosphere is of a tonic character, and the fresh sea-breezes are well calculated to brace and reinvigorate the enfeebled frame. The northern part of the county, particularly the Forest Ridge, is of a much lower temperature. That of the Weald is lower than in the south, but higher than in the north; the climate is, however, agreeable and healthy, and the natives attain to a remarkable longevity.

Agriculture and Productions.—Sussex has been celebrated from the remotest period for the abundance and excellence of its timber, and in these respects it continues to be decidedly superior to every other English county. Oak is the principal timber of the Weald, but in other parts beech is most prevalent. To the abundance of wood is principally to be ascribed the circumstance of Sussex being formerly distinguished for the number of its iron-works; but since coal began to be generally employed in the smelting and refining of iron these have been wholly abandoned, as well as those that were formerly established in Kent. The rich marsh-lands of north-eastern Sussex afford an excellent pasture-ground, where thousands of oxen and sheep are bred and fatted. On the down-lands the soil is thin and unfitted for the plough, but its sweet herbage gives a peculiarly fine flavour to the Southdown mutton. It is kept well cropped to prevent it from degenerating into a rank luxuriance. The usual rotation of crops on the Weald is wheat, oats, clover or trefoil one or two years, and then a fallow. Throughout the county a vast improvement has of late years taken place in husbandry, and on many estates the cultivation will bear comparison with the best English or Scotch farming.

The arable land on the Downs consists of thin light layers of earth, not exceeding 8 inches in depth, intermixed with flint pebbles, and is very favourable for the growth of barley and wheat. The latter is usually sown once in four years, the course being turnips, barley, clover, and wheat, changing the clover for pease or some other crop the eighth year. In some of the hollows the soil is deeper and more loamy.

Hops are cultivated to a considerable extent in the eastern districts. The produce, however, is not so much esteemed in the market as that of Kent or Surrey. Beans, potatoes, rhubarb, coleseed, rye, apples, and figs are grown; and iron, fuller's earth, limestone, and sandstone are met with.

The county is noted for its breed of oxen and for sheep. The Sussex ox bears a strong resemblance to the Devon: it has a small and well formed head, the horns slightly projecting, and then turning upward, thin, tapering, and long, not so as to confound the breeds with the long-horns, and yet in some cases a little approaching to them. The colour is a deep chestnut-red, or sometimes a blood-bay. This ox holds an intermediate place between the Devon and the Hereford, with all the activity of the former and the strength of the latter, with the propensity to fatten, and the beautiful fine-grained flesh of both. The cow is a very inferior animal, yielding a very small quantity of milk, and is principally kept as a breeder.

The Southdown sheep are among the best for all hill countries where the grass is short, and their good quali-

ties have caused them to be bred in almost every part of the country. They have a patience of occasional short keep, and an endurance of hard stocking equal to any other sheep, and an early maturity scarcely inferior to the Leicester, while the flesh is very fine-grained and of peculiarly good flavour. [See SHEEP.] Fresh-water and sea fish are abundant, the former being specially fed for the London market in many ponds on the Weald. The manufactures are only of local importance, consisting chiefly of shipbuilding at the seaport towns, brickmaking, and the manufacture of canvas and leather.

Sussex has been for centuries divided into six rapes, a term peculiar to the county. These divisions are named Lewes, Pevensey, Hastings, Chichester, Arundel, and Bramber. The rapes are subdivided into 68 hundreds and 317 parishes. Nearly the whole of the county lies in the diocese of Chichester. It is in the Home circuit, and the assizes are held at Lewes. For parliamentary purposes it is divided into six divisions, each of which has one representative. Brighton returns two members and Hastings one, making nine representatives in all.

History and Antiquities.—This county derives its name from the kingdom erected by Ælla after his successful expedition in 477, when he assumed the title of king of the South Saxons, or Suth-Sex.

In A.D. 47, when Vespasian received his commission to reduce the maritime districts, Sussex fell under the Roman sway. This being accomplished, he left the government to a British prince, named Cogidubnus, who, if he did not found the city of Chichester, made it the chief seat of his government, which included Hampshire and Sussex. Under the Romans three large towns or fortresses sprang up along the coasts of Sussex, Regnum (Chichester), Mutuantonis, most probably Lewes, and Anderida, of which the site is doubtful, but which was certainly situated near Pevensey.

Ælla, the Saxon, when he came to Sussex in 477, had three sons with him, but two of these were probably slain in battle, for he was succeeded in his kingdom by his third son, Cissa. This principality was bounded on the north by the River Thames, on the east by the newly-established kingdom of Hengst in Kent, on the south by the sea, and on the west by the Britons, still in possession of Hants and Berks. Wessex had been long extending its power over the other Anglo-Saxon states; and Egbert, having defeated the Mercians in 823, despatched a force into Kent, under his son Ethelwolf and Alstan, bishop of Sherburn. The ruling prince, Baldred, fled, and from this time South-Sexe, with Surrey and Kent, and probably a part of Essex, became a subordinate portion of the West Saxon kingdom. King Alfred made his residence occasionally in Sussex, and built several castles for the protection of the coast. In the time of Edward the Confessor, Sussex with Kent was included in the earldom of the famous Godwin, who had become one of the most potent subjects in the kingdom, and exercised within his domains vice-regal power. William the Conqueror landed with his army 28th September, 1066, in Pevensey Bay, near the mouth of the little river Asten. The decisive battle of Hastings was fought on the 14th of October following, at a spot about 9 miles from the place of landing, on a heath then called Epiton, but which thenceforth assumed the name of Battle. By William the county was divided into six rapes (Norm. Fr. *hreppar*, or ropes), extending from the northern boundary down to the sea-coast, and each containing within it a stronghold for its defence and protection. These were the rapes of Hastings, Lewes, Pevensey, Bramber, Arundel, and Chichester.

Of ancient castellated edifices, besides those noticed elsewhere under the names of the various towns belonging to this county, the most remarkable are Amberley and Bodiam, and the castellated mansions of Eridge, Knep, and Scotney. Amberley Castle is situated on the east side of the Arun, 4 miles from Arundel. The gateway is still standing. Bodiam Castle is 4 miles from Robertsbridge, on the Rother, at the extreme eastern side of the county. It was built in 1386. The site forms nearly a square, with four round towers at the angles, and three square ones intervening; the great gateway is flanked by two square towers, and the entrance defended by a machicolation and portcullis. The fortress is surrounded by a very broad moat, which is supplied with water artificially conducted from the Rother, and assumes the appearance of a small lake. The interior was fitted up for a baronial residence. Knep Castle is situated near Horsham; it is a modern castellated building in the Gothic style. Scotney Castle is on the Kent Ditch; the stream which divides the two counties runs through the centre of the castle. It was built by a family of this name about the time of Stephen. At each angle stood a round machicolated tower, but the southern only remains. The whole was inclosed by a moat.

Of monastic remains the principal are the mitred abbey of Battle, the abbeys of Bayham and Robertsbridge, and the priory of St. Pancras at Lewes. The Knights Templars had a preceptory at Sedlescombe, near Battle.

SUSSEX MARBLE. See PETWORTH MARBLE.

SUSS'MAYER, FRANZ XAVIER, a musician, was born at Steyer in Upper Austria in 1766; he died in Vienna, 17th September, 1803. He sang as a boy in the Benedictine abbey at Kremsmünster, and learned the principles of composition from Pasterwitz. Very early he wrote songs, motets, symphonies, and operettas, which were performed; but, impatient of the limited opportunity for the exercise and improvement of his talent afforded by a small provincial town, he went to Vienna, and obtained the instructions of Mozart. He lived in the most intimate association with this greatest of musicians, received daily advice from him, and had sometimes the task assigned him of filling up his master's scores, according to his direction and subject to his revision. Accordingly he habitually copied the characteristics of his handwriting so closely that careful judges have mistaken the MSS. of the pupil for those of the master. He accompanied Mozart to Prague when he went there to produce "La Clemenza di Tito," and assisted the great composer in filling in details. After Mozart's death he was able to fill up considerable gaps left in his splendid requiem, and his almost exact imitation of Mozart's writing and method of composition, coupled with the fact that he was penetrated with Mozart's plans for this particular work, made it a great mystery for long after its appearance. From comparison of what is now known to be Süssmayer's share in this immortal composition with his original work elsewhere, it is abundantly evident that his part is mere reminiscence of ideas actually elaborated by the dying Mozart, and worked out with the voice or the harpsichord sufficiently for Süssmayer to grasp them. Süssmayer was engaged by Schikaneder as musical director at the Theater an der Wien in 1792, and he was appointed to the same office at the court theatre in 1794.

SUSU. See PLATANISTA.

SU-TCHOU or **SOO-CHOW,** a city of China, in the province of Kiang Su, is on the great Imperial Canal, 55 miles W.N.W. of the port of SHANGHAI. It was captured in 1857 by the Taiping rebels, who sacked the place and drove the wealthy inhabitants away. In 1863 it was invested by the disciplined Chinese, under a British officer, to whom the rebel chiefs surrendered, when they were treacherously beheaded by the Tutai, or governor of the province. Su-Tchou is stated to be 10 miles in circumference, and inclosed by fortifications, outside of which are four vast suburbs. It has silk manufactures, a few printing establishments, and some trade in books. The level region around the town is so fertile that it is called by the Chinese a "terrestrial paradise."

SUTH'ERLAND, an extensive county in the north of Scotland, is bounded N. by the North Sea, E. by the North Sea and Caithness. W. by the Minch, and S. by Ross and Cromarty. The length in straight lines varies from 42 to 60 miles, and the breadth from 42 to 54 miles. The total area is 2125 square miles or 1,360,458 acres; and the population in 1881 was 23,370.

There are no islands along the east coast, but a number of small ones on the west and north. Oldany, Calva, and Handa islands are the largest on the west coast; along the north coast the lofty peaks of the Stack and Skerries islands, belonging to the county, are conspicuous in clear weather at a distance of several miles. Some smaller islands are situated close to the coast, and form natural breakwaters, affording protection for shipping.

The aspect of Sutherland is wild and bleak, and in many parts of a savage character. The whole of the interior consists of a succession of mountains and ranges of hills, and some extensive moors, broken and separated by several straths and glens, diverging from the principal valleys, which open towards the sea coasts. Among these ranges one of great altitude, which contains several of the highest peaks in Great Britain, separates the west and north coasts of the county from its southern shores and valleys, and runs in a line nearly parallel with the indented shores of the Atlantic and North Seas. The detached and conical height of Suilven, in Assynt, forms the characteristic and picturesque southern pillar of this lofty range; while Ben More of Assynt, which attains an elevation of 3431 feet, and other mountains, mark with their towering summits its prolongation to within a few miles of the North Sea. The alpine character of this extensive range is also preserved in the magnitude of many lakes at the base of the mountains, in the depth and abruptness of the openings and passes, in the expansion of widely-spread mountain sides and formidable mosses and bogs, and in a variety of romantic valleys and rugged glens and hollows. The western and northern districts of the county, thus separated from the southern and eastern parts, are remarkable for the general ruggedness and inequalities of the surface, and for the vast number of rocky eminences and of second rate lakes which characterize them. The sea-coasts of these two districts also present headlands, promontories, and numerous cliffs of the boldest description. In contrast to these striking and distinguishing features of the west and north, the eastern and southern districts are marked by several extensive and pleasant valleys, by less elevated hills, by rich pasturage, and by valuable tracts of arable land in a high state of cultivation. The sea coast along the eastern shore is also in general flat and sandy.

This county is abundantly watered by many rivers and their tributary streams, partly flowing from extensive inland lakes, and partly formed by the junction of innumerable mountain streams. All these rivers have their source, supplies, and auxiliary streams within the county, with the single exception of the subordinate streams of the Eanack and Carron, which flow through Ross before joining the estuary of the Oykill. The salmon fishing of the larger rivers is very valuable; but with the exception of the intricate and narrow channel of the Frith of Dornoch, and the short estuary of the Fleet, none of the streams are navigable. The Oykill is the chief river: its source is in Loch Aish, a picturesque lake to the east of Ben More of Assynt. It forms the boundary between the two counties of Ross and Sutherland, and after being augmented by the Eanack, Cassley, Shin, and Carron, expands into an estuary, the ancient Portnaculter, but now generally called, at its mouth between Tarbetness and Embo, the Dornoch Frith, and above the town of Tain the Kyle of Sutherland. The other rivers—all of them small and with a short course—are the Shin, Cassley, Fleet, Brora, Helmsdale, Halladale, Strathy, Naver, Torrisdale, Hope, Dionard, Inchford, Laxford, Inver, and Kirkaig. The lakes are Loch Shin (18 miles long), Griam, and Assynt.

The rocks of the county consist chiefly of granite of different colours, gneiss, sienite, quartz, marble, limestone, conglomerate, oolite, sandstone, and sandstone flag. Coal is also found in other parts. Gold has been wrought to some small extent in the strath of Kildonan, about 10 miles from Helmsdale; the metal was of excellent quality, but was found in too small quantities to make the search for it remunerative.

Sutherland has a variable climate, but along the sheltered east coast it is mild and salubrious. The high parts of the interior and the west coast are subject to continued and heavy falls of rain, the injurious effects of which to the human constitution appear, however, to be counteracted by the purity and invigorating quality of the mountain and sea breezes. The valleys are in general well sheltered and cheerful; but in July and August they are often oppressively warm and sultry.

The Dunrobin breed of Highland cattle belongs to the county, and is well known and eagerly purchased in the Lowlands. Sheep of the pure Cheviot breed are, however, by far the most important stock and the staple produce of the Sutherland high grounds. In summer and autumn, and during a portion of the spring season, the county could support a much greater number than it does, provided a supply of winter food could be depended on.

In most of the valleys natural woods of birch, alder, and occasionally oak adorn the steep sides and water edges; but the extensive forests of Scottish pines which, at a remote period, covered the greater part of the interior of the county, have long since totally disappeared. Extensive plantations of fir, larch, and other forest trees have been made.

Several parts of the county have been celebrated for centuries as deer forests, and red deer are still found in great numbers, and of a size and weight not equalled in any other part of Scotland. Roe deer are also common in the woods; and game of all kinds is abundant in all parts. There are no manufactures, but the fisheries (both river and sea) are prosecuted with vigour and success. Helmsdale has of late years grown from a hamlet of three or four cottages into a bustling, industrious, and prosperous village, with all the means of future increase and success, through the active prosecution of the herring fishery.

Formed roads were only commenced in this county in the year 1811; since that period the whole circuit of Sutherlandshire has been provided with roads of the best construction, toll free, and numerous bridges, embankments, &c., all constructed at the expense of the ducal proprietors. Up to the year before-mentioned (1811) the condition of the population was miserable. Their sustenance depended chiefly on their half-starved flocks, and was consequently very precarious—so much so that they would often have died of famine had not their wants been relieved by charity. At last the Duke of Sutherland effected what has been called the Sutherland clearances; that is, whenever a man was living in a place in which, from its situation, he could not support himself properly, he made him either remove to a more fertile spot, or emigrate at his (the duke's) expense to Canada. The tracts thus vacated were then converted into sheep farms.

Nearly the whole of the county, or 1,176,837 acres, is the property of the Duke of Sutherland, and vast sums have been spent by him in opening up the county by railway communication, in recovering land for agriculture, and in improving the condition of the tenantry.

Railway constructions have been among the most prominent of the Duke of Sutherland's improvements. The direct Highland line was carried, at an expense to him of £116,000, from Bonar Bridge to Golspie in 1860. In 1871 he continued it to Helmsdale, chiefly as a measure of

relief to the people of Sutherland, who were in distress through two or three bad fishing seasons. The attempts to carry on the line through Caithness literally to John o' Groats failed until he entered into the project, and in 1874 the railway was successfully completed to Wick and Thurso, so that the traveller may now perform the whole journey from Land's End to the Pentland Frith by rail. Sutherland returns one member to Parliament.

The antiquities of Sutherland consist principally of rude structures of ages so remote as to be lost even to tradition. Upright stones, tumuli, stone battle-axes, and old battle-fields have reference to the invasions of the Danes.

At the earliest period of Scottish history the Thanes of Sutherland figure conspicuously in the transactions of the kingdom, and in the thirteenth century their descendants appear as earls of Sutherland. The succession of the ancient family has continued in unbroken descent down to the present duke, who represents the family through the female branch.

SUT'LEJ (*Satlaj*), one of the five rivers of the Punjab from which the province derives its name. It rises among the Himalayas in Chinese territory, about 30° 8′ N. lat., and 81° 53′ E. lon. The interest of the Sutlej is to some extent absorbed in that of the INDUS, with which it eventually unites, and which is very fully treated in its alphabetical place. The Sutlej, like the Indus, rises on the slopes of the sacred Kailas Mountain, the Elysium or Siva's Paradise of ancient Sanskrit literature, with peaks estimated at 22,000 feet high. It is said to issue from the Manasarowar (Manasa-Sarovara) Lake, which plays so important a part in Sanskrit cosmogony. According to another account, it issues from another and larger lake called Ravana-hrada or Rakas-tal, which lies close to Manasarowar on the west. Mr. Trelawny Saunders states that it rises "in the great lakes named Manasarowar and Rakas-tal." The truth seems to be that these are twin lakes, united with each other, and the Sutlej issues from the Rakas tal, although its effluence from the lake is intermittent.

The Manasarowar had, according to the Hindu mythology, the honour of being also the source of the Ganges, which, of course, is a mere myth. The Sutlej rises near the source, not only of the Indus, but of the Brahmaputra; and the Kailas Mountain is thus ascertained by modern investigations to have a real claim to the position which it holds in Sanskrit tradition as the "meeting place of waters." The Brahmaputra, or rather the Tsan pu, as it is known in Tibet, flows to the east, the Indus to the west, and the Sutlej to the south-west. Starting at an elevation of 15,200 feet, the Sutlej first passes across the plain of Goge—a vast alluvial tract apparently formed from deposits which the river and its mountain-feeders have swept down from the Himalayas. It has scoured a passage across the plain in a channel said to be 4000 feet deep, between precipitous banks of alluvial soil. Near Shipki, the frontier Chinese outpost, the Sutlej turns sharp to the south, and commences its marvellous passage through the Himalayas. It pierces the southern chain of these great mountains through a gorge with heights of 20,000 feet on either side. At Shipki, its elevation is said to be 10,000 feet above the level of the sea. By the time the river has reached Rampur, it has fallen to about 3000 feet, and at Bilaspur, to a little over 1000 feet.

After entering British territory, the details of its course may be sketched as follows. For the first 200 miles it runs through a wild and almost unpeopled mountain country. It receives the Li, or river of Spiti, near Dablang. Thenceforth, the united stream takes a south-westerly direction, through Bashahr and the Simla Hill States, and on entering the British district of Hoshiarpur, takes a sudden southward bend round the spurs of the Siwalik Hills. Debouching upon the plains near Rupar, it divides Umballa (Ambala) district from Hoshiarpur, or the Jullundur (Jalandhar) Doab from the Sirhind plateau. It next flows almost due west, between Jullundur on the north, and Umballa (Ambala), Ludhiana, and Firozpur on the south, till it receives the Beas (Bias) at the south-western corner of Kapurthala State. The united river thenceforward preserves an almost uniform south-westerly direction till its junction with the Indus. Its south-eastern shore is bordered by the districts of Firozpur and Sirsa, and the sterile native state of Bahawalpur; its north-western by the Bari Doab, comprising parts of Lahore, Montgomery, and Multan districts. The whole of its course throughout the plains is fringed by a fertile lowland valley, confined at either side by high banks, which lead to the comparatively barren table-lands above; but the lower portion lies through a much less fruitful tract, partaking largely of the characteristics which mark the desert of Rajputana. Near Machiala, the Sutlej joins the Trimab, and the whole river then bears the name of the Panjnad; and finally falls into the Indus, after a total course of about 900 miles, near Mithankot, at 258 feet above sea-level. Like other rivers having their rise in the Himalayas, the Sutlej attains its greatest volume in June, July, and August. A railway bridge on the Sind, Punjab, and Delhi line crosses the Sutlej at Phillour, and another carries across the Indus Valley State Railway near Bahawalpur. Steamers can ascend the river during the floods as far as Firozpur. The Sutlej has been identified with the *Zaradros* (various reading *Zaradres*) of Ptolemy, the Sydrus, or better reading Hesidrus, of Pliny

antiquity until a very recent period, was limited to the higher castes, among whom it was regarded as a religious duty of a high order. The Puranas contain many injunctions in favour of the custom, some of them asserting that it was the only effectual duty left to virtuous women after the death of their husbands, while others promise thirty-five million years of joy in paradise to those who entered the fire, or award as a penalty for refusal a subsequent re-birth as a female animal. At the same time the older scriptures of the Hindus, the Vedas, for which alone plenary inspiration and authority are claimed, contain no words which enjoin this practice, but on the other hand contain many passages which plainly intimate that at the time of their composition it was unknown. One of the latter passages, however, appears to have been misinterpreted by the Brahmans as containing an injunction to widows to enter the funeral pyres of their husbands, and if the views of many eminent modern scholars be accepted this misreading of a book erroneously regarded as divine was the chief origin of a cruel custom which has caused the sacrifice of innumerable victims. Of course when once the custom became established other sanctions and beliefs would cluster round it, and these would in a short time exercise a greater influence than the original command, and there is every reason to believe that the hopes and fears we have referred to were quite sufficient to secure a voluntary submission on the part of those most affected. It is not unlikely that in solitary instances obedience may have been secured by force, but there can be no question that in the majority of cases the sacrifice was willingly made by those who became suttees. The practice was prohibited by the Mohammedan emperor Akbar in the sixteenth century, but his prohibition does not seem to have had much effect, and it continued to prevail long after the East India Company came into power. In the first quarter of the present century several unavailing

attempts to repress it were made by the Company, but in the twelve years between 1815 and 1826 there were 7154 cases of suttee officially reported in Bengal alone. In 1829 Lord William Bentinck, governor general, with the advice of Mr. B. Bayley and Sir C. Metcalfe, promulgated an enactment declaring all aid, assistance, or participation in any act of suttee to be murder, and to be punishable as such. This measure created much excitement at first in Bengal, the Brahmans denouncing it with great violence as an interference with their religion, and even sending an agent to England with a large sum of money to procure its repeal, but it was rigidly adhered to, and when the natives found the government firm the excitement soon subsided. In 1847, during the administration of Lord Hardinge, the prohibitory edict was extended to the native states, and suttee is now practically extinct. The majority of the Hindus, however, still look back regretfully to the period when the custom was permitted, and as late as 1877, on the occasion of the death of Jung Bahadur, the prime minister of the Nepaul government, three of his widows committed suttee. Unhappily the suppression of the custom did nothing to mitigate the life of discomfort, hardship, and scorn which ignorance and superstition in India associate with widowhood, and it is said that since the suppression of suttee many widows dispose of themselves by poison.

The mode of performing suttee was much the same throughout India, varying only according to the rank of the parties or the customs of each province. In the majority of cases the funeral rites followed the decease of the husband by a few hours only, owing to the exigencies of the climate. While the necessary preparations were being made a drum was beaten through the adjacent villages, and a large company generally assembled to observe the proceedings. The pyre was formed of green boughs, surmounted by a pile of dry fagots mixed with hemp, straw, clarified butter, and other combustibles. In the funeral procession the dead body of the husband was borne upon an open bier, the widow following attired in her best garments, and decorated with wreaths of flowers. She had previously been feasted with sweetmeats, and it was usual to mix certain narcotics with these in order to mitigate the sufferings through which she was called upon to pass. The rear was brought up by a band of musicians and the friends of the family, with the assembled spectators. Arrived at the place of cremation the bier was placed upon the pyre, and the widow was then assisted to ascend it, when she was secured in a sitting posture, holding the head of her husband in her lap. The eldest son or the head man of the village then lighted the pile in several places, and the cries of the victim, if any, were drowned by the noise of the music and the shouts of the crowd. In Orissa the pyre was below the level of the ground, and the widow threw herself d n upon it.

SU'TURE, in surgery, is a term used to designate various modes of sewing up wounds or surgical incisions, so as to maintain the edges in close and even contact. No suture should be used to close a wound until the bleeding has ceased, every foreign substance removed, and exact apposition attained, while bloodvessels, nerves, muscles, or tendons should not be included. The needles used are various in shape and size, straight and cylindrical, triangular, double-edged, and curved, and the threads used include silver wire, catgut, horse-hair, silk, cotton, and hemp. Most surgeons prefer silver wire for sutures that are designed to remain in use for a long time, silk threads being preferred when the suture is to be removed soon after the operation. Among the different forms of suture are the *interrupted*, which consists of a single thread, tied in a knot or bow; the *uninterrupted*, in which an armed needle is passed continuously from one side to the other, until the whole length of the wound is traversed; the *quill* suture, used where some degree of force is necessary to keep the edges of a wound together, which consists of a double ligature, inclosing portions of quill, or any other light stiff rod, as *points d'appui;* and the *twisted* suture, applied with the assistance of hare-lip pins, round which the thread is twisted in a figure of 8.

SU'VAROV-RYMNIKSKI, ALEXANDER VASSILIEVICH, was born in Finland on the 24th of November, 1729. The family was originally Swedish. Suvarov's grandfather was a clergyman, and the father of the future conqueror entered the Russian army in the time of Peter the Great, and was rewarded with the rank of general. This officer was called Basil Suvarov. Hence Alexander, after the Russian fashion, was known as Vassilievich, or Basil's son. The son followed the father's profession, but was destined to be much more illustrious. During the Seven Years' War he acquired, still very young, fame and promotion, and prepared himself by prompt obedience for independent command. In those deplorable scenes which preceded the destruction of Poland as a nation, Suvarov added to his reputation as a soldier. He served with considerable distinction in the war so disastrous for Turkey, so glorious and advantageous to Russia, to which the memorable peace of Kutschuk-Kainardschi, in July, 1774, put an end. The Russian history is full of tragedies the most terrible; it is no less full of episodes the strangest. Peter III. had been murdered to gratify the evil passions of his wife, who afterwards reigned as Catharine II. Before peace with Turkey had been proclaimed, a Kossack adventurer, named Pugatschev, gave himself out as the Czar Peter, saying that the intended assassination had been frustrated. Pugatschev was a bold and resolute man, and he rapidly gained adherents. The alarming insurrection which burst forth failed through Pugatschev's want of political capacity. Suvarov was active and prominent in the conflict with the rebels. In June, 1775, Pugatschev and his principal followers were executed at Moscow. A hundred thousand men had perished in asserting or resisting his pretensions. The next work allotted to the intrepid and energetic Suvarov was the subjugation of the Tartar hordes, over whom, as her empire stretches eastward and southward, Russia strenuously strives to establish at least a nominal supremacy. Insult on insult, injustice on injustice, brutalities the most outrageous, alternating with a Machiavellianism the most cunning and unscrupulous, drove the Turks, half in anger, half in despair, to renew, in 1787, the contest with Russia. The peace of Jassy, in 1792, was a humiliation as profound for Turkey as that of Kutschuk-Kainardschi had been. Suvarov was the most powerful instrument of Russian vengeance. He defeated the Turks at Kinburn, where he was wounded. On the river Rymnik he overthrew an immense host, whereupon the Empress Catharine created him a count, and added to his name that of Rymnikski. The most famous at once and most horrible event of the war was the capture of Ismail, which history shudders to record. In 1794 the Poles, led by Kosciusko, made a sublime attempt to recover their freedom; but against the overwhelming forces of Russia the attempt was of necessity fruitless. At the beginning of November, 1794, the man of blood—Suvarov—having beaten the Poles in the field, approached Praga, a suburb of Warsaw, but on the right bank of the Vistula. Praga was taken by storm, and the carnage of Ismail was repeated. Suvarov, so far from arresting the slaughter, said to his soldiers when it was at the fiercest, "Amuse yourselves, my children," as if the butchery of the defenceless were the best imaginable recreation; he then calmly ordered a cold bath to be got ready, in enjoying which he no doubt thanked God with becoming piety. Certain types incessantly recur in war as in other things. Moreau, the ablest, after Napoleon, of the French generals of the Revolution,

has been compared to Turenne. Napoleon himself resembled in many points Alexander the Great, in many Hannibal; and Suvarov, Blucher, Radetzky, all belonged to a class in which vigour and impetuosity of character supplied the want of the higher order of military qualities. Suvarov was neither an accomplished tactician nor a strategist of genius; he had prodigious pith, indomitable persistency, and he had the instinctive art of communicating to his troops his own fiery and resistless spirit. Early in 1799 the Emperor Paul appointed Suvarov commander-in-chief of the Russian troops which, aided by Austrian armies, were to operate against the French in Italy. For France 1799 was a year of peril, of calamity, and of disgrace. Bonaparte was absent in Egypt; the French government was irresolute, factious, corrupt—neither adopted wise measures nor manifested pertinacious purpose; the French forces were scattered over too many points; and where Napoleonic rapidity, and inventiveness, and grasp were indispensable, leadership was bestowed on such inefficient persons as Scherer. The French in Italy were considerably outnumbered by the Russians and the Austrians, though not perhaps to the extent that French historians represent. Scherer, as Suvarov's opponent, having committed every conceivable blunder, vanished into the obscurity from which it was unfortunate that he had ever emerged. Suvarov had now before him worthier foemen, one of them, Moreau, being much his superior. Scherer had been driven across the Mincio, the Oglio, the Adda. At Cassano, a village on the Adda, Scherer surrendered to Moreau the command of a defeated, dwindling, and discouraged army. In the engagement which took place at Cassano on the 27th April, 1799, Moreau was vanquished by Suvarov, but effected an admirable retreat to the Genoese coast with 20,000 men. On hearing of the reverses of Scherer, the army of Naples, under Macdonald, hastened northward. On the Trebia a battle, extending over three days, was fought in the middle of June, which the French regard as the most obstinate in their annals; Suvarov was victorious over Macdonald, but he said that another such success, so hardly won, would compel the allies to evacuate the peninsula. On the 15th of August Suvarov fought at Novi his last grand battle in Italy. At the head of 70,000 Russians and Austrians he put to flight 40,000 French. The French commander—the young, the noble, the heroic Joubert—was killed. Moreau was present, but most of the movements were contrary to his counsel. As a recompense for his achievements in Italy, Suvarov was made Prince Italijski. Having crossed the Alps into Switzerland with the design of renewing the contest the following spring, Suvarov was suddenly recalled by the capricious Paul. On reaching St. Petersburg he found that he was in disgrace. The courtiers avoided him, and he was not allowed to approach the emperor. Grief at this ingratitude broke his heart, and he died on the 18th of May, 1800. A colossal statue was erected in his honour at St. Petersburg by order of the Emperor Alexander. Suvarov was boundlessly popular with the Russian soldiers and the Russian people, and this popularity was increased by his eccentricities. He has been praised for his disinterestedness, his integrity, and even, away from battles, for his humanity; but with all his virtues he was essentially a barbarian. His son and grandson proved themselves not unworthy his name.

SVEA'BORG or **SWEABORG,** a strongly-fortified maritime town of Russian Finland, on seven islands in the Gulf of Finland, immediately south-east of Helsingfors. The fortifications command the Gustav Sound, the only channel which admits large vessels, and are very strong. The population of the town is about 8000. The Russians took it from Sweden in 1789, and it was bombarded by the Anglo-French fleet in 1854, but without result, except the destruction of some of the buildings.

SWA'BIA, one of the ten circles into which Germany was divided previous to 1806, comprehended the south-western part of Germany, situated between France, Bavaria, Switzerland, Franconia, and the circles of the Rhine. Christianity was introduced among the Suevi, from whom Swabia took its name, at the beginning of the seventh century by the Irish monk Columba. In the year 1080 Henry IV. gave the duchy of Swabia to Count Frederick of Hohenstaufen, under whose successors the Swabians were the richest and most civilized people of Germany. But when the house of Hohenstaufen became extinct in 1268, their vassals, cities, prelates, and counts made themselves independent. On the final dissolution of the ancient constitution of the German Empire, the duchy of Swabia was divided between Würtemberg, Bavaria, Baden, Hohenzollern, Lichtenstein, Austria, and Hesse-Darmstadt.

The name of Swabia, which had disappeared from the map of Germany, has been revived in Bavaria and given to the circle of the Upper Danube. The capital is AUGSBURG.

SWA'BIAN EMPERORS. This great dynasty of mediæval emperors (Holy Roman Empire) and kings of Germany arose out of the series of FRANCONIAN EMPERORS, which made so deep and lasting a mark upon the middle ages; for Conrad III., duke of Swabia, the first of the Swabian house (1138-52), was the son of a daughter of Henry IV. (Henry V., the son of Henry IV., and the last of the Franconian line, left no son.) As Conrad's family name was Hohenstaufen, this line is often called that of the Hohenstaufens. Conrad III., though styled Emperor, was never actually crowned such. This was greatly in consequence of his following the traditional policy of the Franconian Emperors in their opposition to the exalted demands of the Pope; for the coronation was perforce in Italy, and it might have been dangerous for King Conrad to appear there. This antagonism between pope and emperor organized itself finally, in Conrad's time, into the famous opposed parties of the GUELFS and GHIBELLINES, headed respectively by *Welf* of Saxony, a great supporter of the Pope, and by the king's brother, Frederick of *Waiblingen*, whose names, slightly Italianized, are thus perpetuated. Conrad was by no means wanting in religious enthusiasm, anti-Romanist though he might be, and took an active part in the Second Crusade.

The next emperor of the line, nephew of Conrad, was a very celebrated personage—BARBAROSSA. Frederick I. is better known to us by this nickname, given to him on account of his red beard, than by his baptismal appellation, and the article in the present work is accordingly placed under that heading. Frederick I. reigned from 1152 to 1190, and was crowned emperor in 1155. He was drowned crossing a river in Palestine, whither he had gone in the Third Crusade. His son succeeded him as Henry VI. (1190–97); and this prince became possessed of the Norman kingdom of Sicily through his wife. His young son, Frederick II., had already been elected King of Germany, and was by inheritance King of Sicily; but as he was a mere boy at the death of his father he was set aside, and other princes ruled Germany for a time. In 1220 Frederick II. was elected to the German throne, and his chequered career lasted till 1250. In the article under his name it will be seen that this emperor, the patron of poetry and chivalry, the most splendid figure of the middle ages, exhausted what should have been a magnificent career in one long struggle against the unscrupulous animosity of the popes. On the whole the victory lay with Frederick, but it was a personal triumph, and with the noble Frederick the predominance of the empire in European politics passed away. His son, Conrad IV. (1250–54) was never crowned emperor, and was quite deficient in the fine qualities which had so marked his father. With his death the Swabian line ceased.

bristles. The wings are long and pointed. The tail is deeply forked, and consists of twelve feathers, the outermost being greatly elongated. The legs are short, weak, and bare of feathers; the toes are rather long, three in front, and one directed backwards, with the claws moderate, curved, and sharp.

The Common or Chimney Swallow (*Hirundo rustica*) may be taken as the type of the whole. This well-known British bird is very abundant throughout Europe in the summer, extending into Asia; it migrates to Africa, as far as the Cape of Good Hope, for the winter. The swallow arrives in this country about the middle of April, reaching Scotland by the end of that month. The annual migration of the swallows formerly gave rise to many curious speculations to account for their disappearance in the winter, some supposing that these birds spent this season in a state of torpidity, in holes of trees, &c., while others maintained that they retired under water, hibernating in the mud at the bottom of ponds and rivers. There are some curious notes on this subject in Gilbert White's "Natural History of Selborne."

On its arrival in its summer quarters the swallow usually selects a spot for its place of abode, where the habitations of man lie in the vicinity of water. The nest is frequently placed in the interior of a chimney, but it builds readily in almost any suitable sheltered position, under the eaves of roofs, among the rafters of barns and sheds, in the disused shafts of mines, by the sides of old wells, &c.

The nest is built principally of mud or soft earth, collected in small pellets from the edges of ponds and other wet places. These are carried home in the bird's bill and plastered on to the spot selected for the nest; fresh pellets are then brought and added, together with numerous straws and leaves of grasses, and the whole is gradually moulded into the form of an open saucer, attached by one side to the wall of the chimney or other place of retreat. A lining of feathers is then put into the nest, and upon these the eggs are laid; they vary from four to six in number, and are of a white colour, blotched and speckled with ash gray and orange brown, deepening into black. Two broods are reared in the course of the season, the first being ready to fly by the end of June, and the second brood about the end of August. The first brood depart southwards by themselves at the end of August or the beginning of September, and as they are fat and of good flavour at this time they are captured in some parts of Europe in great numbers. The parent birds and the second brood depart about a month later for the most part, though some linger even as late as December. Despite the affection of the swallow for its young, the old birds sometimes desert their second brood of nestlings if the latter are unable to fly when the time for departure arrives.

The swallow passes almost its whole existence on the wing, and its flight is very swift and graceful. The food of these birds consists of insects, in the pursuit of which they may be seen skimming close to the ground and over the surface of the water; they drink and feed their young also on the wing. The swallows are courageous birds, mobbing and putting to flight a hawk or other bird of prey which may intrude upon their domain. The note of the male bird is very sweet. The swallow measures about $8\frac{1}{2}$ inches in length, of which the tail occupies nearly 5 inches, so that the body of the bird is very small. The colour of all the upper parts, together with the upper part of the breast, is black, with violet tints; the forehead and throat are chestnut brown; the lower part of the breast and the abdomen are rusty white; and the inner webs of the tail feathers, except the two middle ones, are spotted with white. The outer tail feathers in the male are twice as long as the rest. They are rather shorter in the female; but in both sexes nearly the whole of the inner web of these feathers is white.

There are several allied species of swallows in North America and other parts of the world. Two well-known species of this family are also British birds, the House Martin (*Chelidon urbica*, see MARTIN) and the SAND MARTIN (*Cotyle riparia*). The so-called swallows which construct the edible nests so much prized by the Chinese are swifts. See NESTS, EDIBLE.

SWALLOW HOLES are the large POT-HOLES in limestone districts receiving streams of water, which descend by them to more or less lengthy subterranean channels. Some interesting observations upon those of Ingleborough, in Yorkshire, will be found in a paper by Professor M'Kenny Hughes, read before the Victoria Institute, 21st February, 1887.

SWALLOWING is by no means the simple operation that it might appear. A brief account of the various divisions of the act is given at the beginning of the article DIGESTION.

SWAN (Cygnus) is a genus of birds belonging to the subfamily Cygninæ, family Anatidæ (DUCKS). The swans have a bill about as long as the head, of equal breadth throughout its length, higher than wide at the base, depressed at the point, and with both mandibles furnished along the sides with transverse serrated lamellæ. The nostrils are oblong, lateral, near the middle of the beak. The neck is slender and very long. The legs are short; the hind toe is small and free. The wings are long and powerful. The tail is short and rounded.

The peculiarities of organization in this group deserving of notice are the great length of the neck, consisting of twenty three vertebræ, and the cavity in the sternum for the reception of a great portion of the trachea, reflected back, and doubling upon itself before entering the chest.

The genus Cygnus is extensively distributed, and the species are migratory in their habits. They take up their abode along the margin of large rivers, lakes, and sheets of water, raising a high nest of accumulated vegetable matters, so as to be secure in times of floods or during the tidal influx. The young, or Cygnets, are of a brownish-gray, the pure white colour not being acquired until the beginning of the third year. Their food consists chiefly of the seeds and roots of aquatic plants, grasses, &c., but they also devour aquatic worms, insects, frogs, and the spawn and fry of fishes. They are gregarious in their habits. They are awkward upon land, but fly well and high in the air.

The Wild Swan or Whooper (*Cygnus musicus* or *Cygnus ferus*) breeds in the more northern parts of Europe and Siberia, visiting in the winter Britain and Central and Southern Europe. Its winter migration extends to China and Japan in Asia, and to Lower Egypt and Algeria in Africa. In former times it appears to have bred in the Orkney Islands. The Wild Swan is about 5 feet in length. The plumage is pure white; the legs and toes are black; the anterior part of the bill is depressed and black, while the basal part is quadrangular and yellow, the latter colour extending forward along the margin of the upper mandible beyond the nostrils, which are black. The plumage of the cygnets is pale brown. The nest consists of rushes and coarse herbage. The note of the wild swan resembles the word "hoop" uttered several times successively. They fly in a wedge-like figure, uttering this note as they proceed, and when heard from above it is not unmusical. This intonation arises from the length and duplicature of the trachea in the sternal chamber. It breeds in captivity. This species is in all probability the swan so much celebrated by the ancient poets for its dying song, a fiction which was long ago exploded.

Bewick's Swan (*Cygnus Bewicki*), which is about one-third smaller, breeds within the Arctic Circle, chiefly in Siberia, and visits Europe on migration. It is a tolerably frequent visitor to the British Islands in severe winters, and in Ireland is more abundant than the whooper. The call-note of this species resembles the word "tong."

The Polish Swan (*Cygnus immutabilis*, Yarrell), is a native of the high northern regions, a few specimens of which have been shot in Britain. The cygnets are white, with a slight yellowish tinge. The legs and toes are pale ashy grey, and the bill is orange beyond the nostrils. It is doubtful if this is a true species.

The Common or Mute Swan (*Cygnus olor*) is well known in its semi-domesticated state on our rivers and sheets of waters. It is not indigenous in our island. This species breeds in the wild state in Denmark, the South of Sweden, Central and Southern Russia, and the valley of the Lower Danube. Flocks are found both wild and semi-domesticated in many parts of Germany, and a few breed on the lakes of Greece and in Turkestan. In winter it occurs on migration throughout the greater part of Europe, extending to North India, Egypt, and Algeria.

The tame swan is from 4 feet 8 inches to 5 feet in length, and weighs about 30 lbs. It has been known to live for at least fifty years. The bill is a rich reddish orange in front, and black at its basal part, thus contrasting strongly with that of the wild swan, in which the position of the two colours is reversed. At the base of the upper mandible is a prominent black tubercle or knob, which is of considerable size in old males; and at its tip is a black nail. The body of the female is smaller and deeper in the water, and the neck is more slender. The young cygnets have a dark bluish-gray plumage, and a lead-coloured bill, the plumage becoming gradually lighter with the progress to maturity; they are quite white at the end of two years, and breed when three years old.

In the breeding season the swans live in pairs, each pair keeping to its own part of the water, and at this time the male becomes exceedingly fierce, attacking any animal which intrudes upon his domain. The nest is formed of a mass of reeds, rushes, and other coarse herbage, and is placed on the ground close to the edge of the water, generally on an island. The eggs are large, six or seven in number, and of a dull greenish-white colour. Incubation lasts six weeks, and the young are hatched about the end of May. When hatched the young birds are conducted to the water by the parents, and occasionally the mother will even take her family upon her back and swim along with them. The whole family remain together during the winter, and in the spring the young are driven away by the old birds. The voice of the swan is soft and low, rather plaintive and with little variety; the trachea is not convoluted, as in the wild swan.

The tame swan is said to have been introduced into England from Cyprus by Richard I.; the first notice of it occurs in a manuscript of the time of Edward I. In former days, although the flesh is dark and tough, it was highly prized for the table, and was served up at every great feast. In England it has been for long protected by special laws, and is regarded as a royal bird, all found at large on a public river or creek being presumed to belong to the crown, unless a special grant has been made, in which case together with the privilege a special swan-mark is granted. These swan-marks are cut in the skin of the beak. Tame swans may, however, be kept in private grounds. The Dyers' and Vintners' Companies have long enjoyed the privilege of preserving swans on the Thames, and the ceremony of marking the birds is still performed annually. [See SWAN UPPING.] In the language of the swan-herds the male is called a *cob*, and the female a *pen*.

There are two species of swans in North America, the American or Whistling Swan (*Cygnus americanus*), and the Trumpeter Swan (*Cygnus buccinator*), the latter being rather larger than the whooper. Both breed in the north of North America, migrating to the United States in winter.

The Black Swan (*Cygnus atratus*), a native of Australia, is a remarkable exception to the white birds above-mentioned. It is rather smaller than the common swan, of a deep black colour, with the exception of the primaries, which are white, and the lower part of the belly, which is of an ash colour. The bill is orange-red, and the feet are brownish. It has been introduced into this country and breeds freely in captivity. In a state of nature the black swans are generally seen floating on some lake or pool in flocks of eight or nine. When disturbed, they generally fly off in line or single file; and are so shy that it is difficult to get within gunshot. Their note is far from harsh, at least when uttered in captivity.

SWAN'S SONG. An ancient Greek tradition will have it that the swan sings sweetly immediately before her death; but, as Pliny had already announced in the first century of our era ("Olorum morte narratur flebilis cantus, falso ut arbitror aliquot experimentis"), this opinion always proved false when put to the test of actual experiment.

The myth has been seized upon by the poets, however, and we could ill spare the graceful lines which embody it. Thus Shakespeare ("Merchant of Venice," iii. 2) says of Bassanio,

> "Let music sound while he doth make his choice:
> Then, if he lose, he makes a swan-like end,
> Fading in music."

Again, in "King John" (v. 7), the prince, looking on the dying king, who has enjoyed a momentary ease from pain, and has sung a phrase of music, cries —

> "'Tis strange that death should sing,
> I am the cygnet to this pale faint swan,
> Who chants a doleful hymn to his own death."

Or again, in "Othello" (v. 2), the dying Emilia, thinking of Desdemona's song, says—

> "What did thy song bode, lady?
> Hark, canst thou hear me? I will play the swan,
> And die in music: (*sings*) 'Willow, willow, willow.'

and he has similar touches elsewhere. The same might be said of almost all our great poets, who in this, as in many other matters, decline to be fettered by bald facts if they can plead a precedent for fictions which are fairer.

A very beautiful collection of songs left finished by Schubert were published under the taking title of "Schwanengesang," *i.e.* Swan's Song, and are always now known by that name. They have no inner connection, like his "Miller" cyclus, or his "Winter Journey."

SWAN UPPING, or SWAN HOPPING. The swans on the river Thames are owned in the largest number by the queen, and next by the companies of vintners and dyers; but the birds are far less numerous than they used to be. The swan-marks are made upon the upper mandible with a knife or other sharp instrument. The swan upping, or hopping, that is, the catching and taking up the swans to mark the cygnets, and renew the marks on the old birds if obliterated, in presence of the royal swan-herdman, is still continued annually by the civic companies.

SWAN-MUSSEL (Anodon or Anodonta) is a genus of lamellibranchiate molluscs belonging to the family Unionidæ (RIVER MUSSEL). The shell is thin and toothless, but the valves are united by a strong ligament; it is oval, smooth, compressed when young, but becoming inflated with age. The foot is very large, compressed, and tongue-shaped. The eggs are hatched in peculiar brood-pouches of the outer gills. The embryos are so unlike the parent that formerly they were thought to be parasites, and received the name Glochidium. They have a triangular gaping bivalve shell, with the apex of the valves produced into a strong tooth, and a rudimentary foot with a long byssus. On leaving the body of the parent the Glochidium swims by the flapping of its valves, and attaches itself to some

floating object, usually a fish, by the strong teeth of its shell. In this position it undergoes a gradual metamorphosis into the form of the adult animal, and at length drops off into the mud. The species of Anodon are very numerous and widely distributed in America, Europe, and Northern Asia, inhabiting canals, ponds, and sluggish streams. The common Swan mussel (*Anodonta cygnea*), the largest of European fresh-water mussels, is common in ponds and rivers in Britain.

SWAN'SEA, in Welsh *Aber-Tawe*, a municipal and parliamentary borough and seaport in Glamorganshire, 204 miles west from London by the road through Bristol to Milford, and 216 by the Great Western and South Wales railway, is situated on the west bank of the Tawe, at the junction of that river with Swansea Bay, in the Bristol Channel.

Swansea consists chiefly of three or four long semicircular streets following the bend of the river. The ground rises inland, at first slowly, and afterwards rapidly, and the town is thus divided into the lower town to the south, and the upper town to the north. The western portion, which is the newest, is covered with streets of handsome private houses and rows of villas. Swansea is clean and well-built, most of the better class of houses, as well as the public offices, being of modern erection, and it has an excellent supply of water. The waterworks were completed in 1868. Their principal feature is a vast reservoir, formed by an embankment across the Lliw Valley, about 8 miles from the town. Swansea contains several modern churches, a Roman Catholic, and numerous chapels for different denominations of dissenters; a fine synagogue, guildhall, council chamber, and public offices; banks, post-office (one of the handsomest structures of the kind in the provinces), handsome station, harbour offices, barracks, on the site of an ancient castle, house of correction, baths, market-house, 320 feet long, Royal Institution of South Wales, with a museum and library, public library, opened in 1887, containing upwards of 30,000 volumes, theatre, music hall, free grammar school, union, hospital, and sailors' home.

Swansea is situated in the midst of a very extensive and productive coal field, and it is now one of the most important towns in Wales. The coal obtained is peculiarly adapted for smelting purposes, and owing to this circumstance the town has become the principal seat of the copper-smelting trade in Great Britain, the greater part of the ore raised in the kingdom being smelted here. Ore is also brought from Cuba, Australia, and Chili. In addition to the copper smelting, there are silver, nickel, cobalt, brass, iron, zinc, tin, and alkali works; manufactories of patent fuel (made of culm and tar into the shape of bricks); potteries, tanneries, rope and shipbuilding yards. Several canals and railways, ascending the Tawe and Vale of Neath, place the town and harbour in direct communication with the collieries and the different industrial establishments along the Tawe valley.

The peninsula of Gower and the headland of the Mumbles shelter the Bay of Swansea, which is more than 9 miles wide, from the south-west gales, and render it an advantageous roadstead for vessels of large burden. Swansea harbour in 1849 was simply a tidal harbour formed in the old bed of the river Tawe, whereon vessels lay aground at low water. Between the years 1860 and 1861 the North and South Docks were completed, and by 1863 were connected with the Great Western, the London and North-western, and Midland railways, as well as with the various branch lines of railway to the Welsh coal-fields. The North Dock, opened in 1852, covers 14 acres, with a lock 56 feet by 100, and a depth of 25 feet of water over the sill at spring tides. The South Dock, opened in 1859, is a trifle larger, being 18 acres in extent, with a lock 300 feet long, entrance-gates 60 feet wide, and the same depth as its neighbour. The East Dock, opened in 1881 by the Prince and Princess of Wales, was commenced in 1879. The entrance lock is 500 feet in length between the gates, and is 60 feet wide, the depth of water over the sill being 32 feet at ordinary spring tides. The water area of the dock is 24 acres, walled all round to the height of 38 feet above the bottom, the length of the quayage being upwards of a mile. The number of vessels registered as belonging to the port in 1887 was 200 (65,000 tons). The entries and clearances each average 7200 (1,400,000 tons) per annum. The chief exports are coal, copper, iron, tin, and pottery. Large quantities of patent fuel made in the town are also exported. A pier at the west of the town, about a third of a mile in length, forms a delightful promenade for inhabitants and visitors.

The municipal borough is divided into four wards, and is governed by six aldermen (one of whom is mayor) and eighteen councillors. The population of Swansea in 1801 was 6831, and in 1841 it had only increased to 16,787; in 1881 the number of inhabitants in the municipal borough amounted to 63,739. The parliamentary borough, which since 1885 has returned two members, had, in 1881, a population of 100,590. The name of Swansea, or as it is called by Camden, Sweinsey, is supposed to have been derived from the shoals of porpoises or sea-hogs that frequented the bay, or as some assert, from its having been a landing-place of Sweyn, a Danish freebooter. The castle, whose massive tower is still a conspicuous object, was originally founded here in 1099 by Henry de la Bellamonte, earl of Warwick, who introduced into it a garrison of English and Flemish colonists who were settled in the peninsula of Gower. In the parish church there is a monument to the lady who was married to Perkin Warbeck, and her second husband, Sir Matthew Cradock, the high steward of Gower.

SWARTZ'IA is a genus of plants belonging to the order LEGUMINOSÆ. There are about sixty species, nearly all natives of tropical America, large forest-trees, producing hard durable timber. *Swartzia tomentosa* forms a high thick tree, and grows on the borders of rivers in Guiana. It has a fine reddish-coloured wood, which is considered very indestructible. The bark is very bitter, and is used as a medicine. A resin is also obtained from the bark.

SWEARING, PROFANE, is an offence, according to the law of England, for which a person may be convicted by a justice of the peace and fined according to his station in life. The full penalty which may be exacted for each profane oath or curse is—for a day labourer, soldier, or sailor, 1*s.*; for every other person under the degree of a gentleman, 2*s.*; and for every person above the degree of a gentleman, 5*s.* By 22 Geo. II., c. 33 persons belonging to the navy guilty of profane oaths or curses were made liable to punishment by court-martial. A justice of the peace may convict a swearer without further process or evidence should the offence take place in his presence, and constables are empowered to arrest profane swearers, and to carry them before magistrates or justices for sentence. These laws, however, have never been supported by public opinion, and though they are occasionally put in force by individuals, they are, as a rule, wholly disregarded.

SWEAT. In the article SKIN the separate secretions of the sebaceous follicles and the sweat-glands proper are referred to; and it is stated that the sweat, as is familiar to every one, passes off in vapour as a rule, the so-called "insensible perspiration," and it is only under the great flow caused by strong exercise, heat, closeness, &c., that the secretion occurs in drops, and is more particularly known as sweat. It is evident, therefore, that the sweat is not so purely the special skin secretion as the insensible perspiration, because, as it collects in watery drops on the surface of the skin, it absorbs any substances which it finds there, the sebaceous secretion, for example, and other things. Very little of the true excretory work of the body

is done by the bowel; the fæces are nearly entirely made up of undigested matter. Of the other agents of excretion the *kidneys* dispose of the urea and most of the salts, with the largest quantity of water, the *lungs* of the carbonic acid and a considerable quantity of water, and the *skin*, in the form of sweat, of all the remainder of the water, and a small quantity of salts and of carbonic acid. The amount of water excreted as insensible perspiration and sweat is more than half as much again as that disposed of by the lungs; and experiments with air-tight dresses, &c., have indicated that while, on an average, a healthy man, not undergoing exercise and in cool weather, loses probably about 2 lbs. weight a day, it is easy to force no less than 20 lbs. weight through the skin by stimulating its secretion with warmth or exercise.

The amount, and to a certain extent the character of the sweat, is largely influenced by the nature of the food, especially the drink, and by the physical and mental condition of the individual. It also depends upon the state of the other great excreting organs, the lungs and the kidneys, and they on it; each one of the three replacing the others at need.

Save for the worn-out scales of the outer skin the sweat has no structural elements. It contains about $1\frac{3}{4}$ per cent. of solids, chiefly ammonia and common salt with other salts; the rest being minute amounts of the fatty acids, formic, acetic, butyric, and (as shown by the odour) caproic and caprylic acids. A little neutral fat is also present, and cholesterin. In various diseases the sweat is altered; it may contain blood ("bloody sweat"), albumen, urea and uric acid, sugar, lactic acid, bile, &c., and also certain substances taken as medicines have been discovered to be exhaled by the skin.

SWEATING COINS is effected by shaking them a long time in a bag in considerable quantities, whereby some of the metal is rubbed off. The bag is burnt; and in the fire the metal collects in drops. As the process of the sweater is simply a condensation of that of ordinary wear and tear, it is difficult to discover. Probably it is not a common crime, yielding a rather small profit for the labour employed.

SWEATING SICKNESS, a terrible disease which visited England five times, 1485, 1506, 1517, 1528–29, and 1551, and which was known as the *Sudor Anglicus*, from its being at first confined to these shores. At its fourth visitation it crossed to Germany and inflicted fearful ravages. It spread from there to the Netherlands, Denmark, and the Swedish peninsula. It is not recorded before 1485, and has happily never been heard of since the autumn of 1551.

It arose from the battle of Bosworth, and probably was some form of typhus caught from the putrefying bodies of that fearful carnage. Henry VII.'s victorious army marched to London from Bosworth field in August, 1485, carrying the seeds of this awful scourge with it. In a few days it broke out. The lord mayor died, and his hurriedly chosen successor followed him, with six of the aldermen, in the first week. A corresponding mortality raged among the citizens. The rapidity of the disease was among its chief terrors—all was over in a few hours. A violent fever culminated in a rigor, and stupor at once followed with a horribly fetid perspiration, copiously poured out all over the body. Holinshed says, "Suddenly a deadly burning sweat so assailed their bodies and distempered their blood with a most ardent heat, that scarce one among an hundred that sickened did escape with life; for all in manner, as soon as the sweat took them, or a short time after, yielded the ghost." The new king, eager as he was to assure his rule by public coronation, hurriedly left the capital and put off the ceremony. All business ceased. Half-clothed women ran frantically about the streets, and bells tolled for the dying by night and day. After the first virulence was exhausted the disease still continued, spreading over the country, and always blazing out as fiercely as it had done in London, then dying down to the dimensions of an epidemic. On the 1st January, 1486, a great storm arose, and it was held at the time that the air was so purified by its violence that even the fearful sickness was washed away.

In 1506 the sickness occurred in London and caused much alarm. In 1517 it appeared in force and spread all over England, raging with fury for at least six months. It was taken to Calais by the English garrison, but did not extend further. In 1528 a series of heavy rains rotted the corn in the ground, and famine was felt far and wide. Upon this the sweating sickness reappeared, and its effect upon the half-starved people was disastrous in the extreme. All private and public business ceased, and Parliament was hurriedly dismissed. The king (Henry VIII.) fled from the pestilence, but as soon as he reached any place of refuge the sweating sickness approached it. At last, with Queen Catharine of Aragon and his small suite, he stayed in Tittenhanger, refusing further attempts to avoid his fate. Fires were lit all round the house, and burnt day and night all through the "great mortality." It is not known how many people perished. Probably they would be counted by hundreds of thousands. It was many months before the pestilence wore itself out.

In 1551 it appeared in the summer at Shrewsbury: spread into Wales, and then to London and the south. It arrived at London in July, then crept up the east coast till it had covered all England. Public alarm was at its height when the plague began to abate, and it rapidly fell till in the autumn it passed away, we hope, for ever. It did much damage in Germany in 1529 and at this time. Curiously enough it never attacked either Scotland or Ireland.

Dr. Kaye, the eminent physician, and founder of Caius College, Cambridge, has left a careful record of the outbreak of 1551. He says: "Its sudden sharpness and unwont cruelness passed the 'pestilence.' For this commonly giveth three or four, often seven, sometimes nine, sometimes eleven, and sometimes fourteen days' respect to whom it vexeth. But that immediately killed. Some in opening their windows, some in playing with their children at their street doors, some in one hour, many in two, it destroyed; and at the longest to them that merrily dined it gave a sorrowful supper. As it found them so it took them; some in sleep some in wake, some in mirth some in care, some fasting and some full, some busy and some idle: and in one house sometimes three, sometimes four, some times seven, sometimes eight, sometimes more, sometimes *all!*"

SWEDEN (*Sverige*), a country in the north of Europe, comprising, with Norway and Lapland, the whole of the Scandinavian Peninsula, of which it forms the eastern, southern, and most important portion. On the east of Sweden, from its southern extremity to 66° north lat., extend the Baltic and the Gulf of Bothnia, which divide it from Russia. North of the Gulf of Bothnia it is separated from that empire by the Tornea-Elf, the Muonio, and the Köngämä, a feeder of the Muonio, which has its source in the small lake of Koltejaur, on the boundary of Norway. On the west the country is bounded by Norway, the Skagerrack, the Cattegat, and the Sound. South of Sweden is the western part of the Baltic, which separates it from Germany. The length of the kingdom from south to north is about 950 miles; its width varies from 150 to 250 miles. The area is 170,979 square miles, exclusive of a great number of islands lying close to the coast, most of them of very small dimensions. The population in 1867 was 4,195,681, and in 1870 4,158,757. The decrease in population from 1867 to 1870 was owing to a strong tide of emigration having set in, which has since abated, and in

1884 the population had risen to 4,642,128—2,252,233 males, and 2,390,895 females.

Coast, Islands, Surface, Mountains, &c.—The shores of Sweden, about 1400 miles, exclusive of the deep inlets, have great peculiarities. On the eastern side, around Carlscrona, but principally from the Sound of Kalmar into the interior of the Bothnian Gulf, there is along shore an enormous assemblage of small rocky islands and insulated points of rock, forming a bewildering maze, which no map can represent owing to their number. The country, according to a common saying, has two coasts—one inner and the other outer. The inner is an integral part of the mainland; the outer is the islet fringe closely bordering upon it, in which there is smooth water when the sea beyond is tempest tost. Nothing like it occurs elsewhere in European scenery. Though all the members of this archipelago are of insignificant extent, and are never elevated, while rounded surfaces render the scene exceedingly monotonous, its aspect is singularly impressive to the stranger, from the apparently interminable extent of the labyrinth and the want of life in connection with it. Along the most northern part of the Gulf of Bothnia the shore is low, and consists of sandy alluvial soil, brought down by the numerous rivers. It begins to rise as it approaches the Quarken [see BOTHNIA, GULF], and as far as the town of Gefle it presents an alternation of low and moderately-elevated shores. The projection between Gefle on the north and Bråviken Bay near Norrkoping on the south has a rocky shore of moderate elevation, indented by numerous inlets. The islands, which are innumerable, consist of rocks only a few feet above the sea, and many of them are surrounded by sand-banks. South of Bråviken Bay to the Island of Oland the shore is partly rocky and somewhat elevated, and partly low and sandy. It is intersected by many inlets, all of which run E.S.E. and W.N.W., so as to give to this part of the country nearly the appearance of a saw. The rocky islands are so numerous as to render the access to the mainland very difficult. The west coast of the Straits of Calmar, which divides the island of Oland from Sweden, runs in a less broken line, and is generally low. From Cape Tornhamnsudde or Terru mudde, a low rocky point east of Carlscrona, the land suddenly turns to the west, and is rocky and elevated to within a few miles west of Carlshamn. It contains many good harbours, which are sheltered by the numerous islands that line the coast. The shores of the peninsula of Scania, the most southern part of Sweden, are low, sandy, and free from islands and rocks. There are some extensive marshy tracts along the sea-coast in other parts of the country. The largest and also the most distant island is GOTHLAND, in the Baltic. Oland or ALAND is the only other of importance.

The interior is not generally mountainous, and its surface has far less of a highland than of a lowland character. The most elevated portion, called the Scandinavian Alps, commences in the west, near the parallel of 62 degrees, and is continued north along the frontiers of Norway, not so much in a continuous chain as in isolated mountain masses rising from an elevated table-land, which, where loftiest, is at least 4000 feet high, and forms the base of several summits which rise more than 6000 feet above sea-level; owing to their high latitude they are covered with perpetual snow. The two loftiest peaks, both partly within the Norwegian frontier, are Sulitelma, 6342 feet, and Sylfjellen, 6552 feet high. These mountains and their table-land decline east towards the Gulf of Bothnia, sending down numerous torrents, which in their course often expand and form chains of lakes and dreary swamps. The same slope is continued south of 62° N. lat., but besides it there is a south descent, which attains its lowest level near 59° N. lat., on the shores of the magnificent lakes which here stretch almost continuously across the country from east to west. To the south of 59° N. the surface is generally flat, though in many parts finely diversified. Its loftiest height, Mount Taberg, to the south of Lake Wetter, is about 1129 feet, and a considerable part of what is called the table-land of Smaland is 800 feet above sea-level, but the far larger portion is under 300 feet. Both its level and latitude point it out as a region which should naturally be well adapted for agriculture, and it has several fertile and well-cultivated tracts; but the soil, generally consisting of disintegrated primitive rocks, in which silex is a principal ingredient, is by no means productive. A considerable portion is covered with sand or stunted heath, but interspersed with forests, green meadows, and corn-fields. The finest tracts are the space inclosed between Lake Wetter and the Bay of Bråviken on the south, and Lakes Hielmar and Maelar on the north, the plain of Linköping, the län of Carlscrona, and generally what is called the plain of Scania, occupying the whole of the south peninsula between the Sound on the west and the Baltic on the south and east.

Geological Character.—The geology of Sweden, although interesting from the character of its rocks and the mineral treasures which many of them contain, does not present much variety in its formations. Almost the whole of the country throughout its length and breadth is composed of gneiss, partially penetrated by granite. Patches of porphyry and greenstone, of Silurian rocks, of oolite, and of cretaceous rocks, appear in various localities. A remarkable geological feature of Sweden is the presence of a vast number of enormous erratic blocks of granite scattered over its surface; in the south they are collected in long spits or tongues, resting upon the plains, which are quite unconnected with them; more to the north they are scattered indiscriminately, and so profusely that scarcely an acre of land is without one or more heaps of them. They also form many islands in the lakes. A line is supposed to traverse the country in lat. 66° 3′ N., above which, to Cape North, the land is rising at the estimated rate of 4 feet in a century, while south of it it was formerly believed there was a slow and gradual subsidence; but modern observations do not confirm the latter belief.

Lakes, Canals, Rivers.—The lakes in Sweden are very numerous, and have been estimated to cover 22,000 square miles, or one-eighth of the entire area of the kingdom. The largest, the Wener, which is 90 miles long and from 15 to 48 broad, is traversed by 59° N. lat., and has an area of 2000 square miles, being in size the third in Europe. The surface is 144 feet above the sea-level. Two headlands projecting from the northern and southern shores divide it into two unequal parts, of which the western is called Lake Dalbo. The shores are lined with rocky islands. Lake Wener receives numerous rivers, especially from the north. Its largest feeder is the Klar, which issues from the south-western extremity of Lake Fämund in Norway, and after a rapid southern course of more than 70 miles enters Sweden a little north of 61° N. lat., and runs southwards for more than 120 miles. About 60° N. lat. its course is broken by rapids and cataracts. Below this point the river runs with less rapidity, but it cannot easily be navigated except in the last 20 miles of its course. Near its mouth it divides into two arms, which inclose the island of Tingwalla, on which the town of Carlstad is built. The waters of Lake Wener are carried to the Cattegat by the Göta, which runs south by west more than 50 miles, and about 14 miles from its mouth divides into two arms, inclosing the Island of Hisingen. In its natural state the river was rendered unfit for navigation by several cataracts in the first 18 miles of its course, within which distance the stream descends about 130 feet, but by means of canals and locks it has been rendered navigable for vessels of light draught. The West Göta Canal traverses Lake Vicken, and connects Lake Wener with Lake Wetter, which occupies the centre of Southern Sweden, and is about

80 miles long and 10 broad. Its surface is 288 feet above the sea, while at the distance of a few miles east and west the level country is several feet lower. It partakes of the nature of an Alpine lake, being in one place more than 420 feet deep. Its feeders are partly torrents; it is subject to heavy gales and sudden variations in its level, but is of great importance for internal traffic. The Eastern Göta Canal, which unites Lake Wetter to the Baltic, is about 64 miles long, inclusive of the lakes which it traverses; it extends along the bank of the river Motala eastward to its efflux from Lake Roxen, whence it continues in a straight line, and enters the Baltic by the inlet of Släte Baken, 2 miles below Söderkoping. The line of water-way thus traced from the town of Gothenburg on the Skagerrack to Söderköping on the Baltic, was completed by Telford; it gives Sweden an inland navigation of 260 miles, unites the Atlantic Ocean with the Baltic Sea, and very considerably shortens the route from the Cattegat to Stockholm. In order to avoid the falls of Trolhaetta a cut of nearly a mile in length was made in the solid rock; and altogether this canal, or rather series of canals, is one of the most magnificent in Europe. Lake Hielmar, which extends about 35 miles from east to west, and is from 2 to 8 miles wide, lies N.N.E. of Lake Wetter. It communicates by a canal and locks with Lake Maelar, which differs greatly from all the others in Sweden. It consists of many small lakes, united by short channels, which inclose islands. From what may be called the main body of the lake several narrow but navigable arms branch off to the south and north, and penetrate to a great distance inland. Its length exceeds 60 miles. It is nearly on a level with the Baltic. The advantages of the navigation on Lake Maelar have been increased by the Södertelge Canal, a cut about 2 miles long, which unites one of its arms with a deep inlet of the Baltic, called the Järne Fiord. Steamers and other vessels that ply on the Gota Canal reach Stockholm by this route, which has the advantage of some romantic scenery. The Strömsholms Canal, leading to Lake Barken, in the region of the mines, joins the Maelar lake near its western extremity.

Sweden is watered by numerous streams, but has few naturally navigable rivers. Those south of 60° N. lat. have generally a short course, but north of that line there are several which run nearly 300 miles, descending from the Kiölen range to the Gulf of Bothnia. The largest is the Dal, formed by the junction of the Oster, which traverses Lake Siljar and the Wäster or Fulu; the general course of the branches and of the united stream is nearly south-east to near Avesta, where the Dal turns east by north, and forming several lakes enters the sea a little south of Gefle. About 6 miles from its mouth it forms the magnificent cataract of Elfcarleby. Further north is the Ljusnan or Ljusne, whose most remote branches originate on the southern declivity of Mount Sylfjellen. It flows with a very rapid course, forming several cataracts, and falls into the Gulf of Bothnia, south of Söderhamn, after having run about 200 miles. Further north the Gulf of Bothnia receives the Ljungan, the Indals, and the Angerman. The rivers of Bothnia are noticed under BOTHNIA.

Climate.—The climate of Sweden is mild for its northern position; and the west coasts are more mild and moist than the east. The difference in the temperature of various places is chiefly to be attributed to the difference of latitude and elevation above the sea-level. The most northern point of the country lies 2½ degrees north of the polar circle; the most southern is situated nearly 11 degrees south of it. A small portion of the surface is so elevated that it is always covered with snow; and large tracts along the sea-coast are only a few feet above the sea. The elevation at which perpetual snow occurs is less as we proceed further north. Near 60° N. lat. it is about 5600 feet, at 61° 5400 feet, at 62° 5100 feet, at 64° 4650 feet, and at 71° 2300 above the sea.

The mean annual temperatures of the following five places south of 60° N. lat. are as follows:—

Place.			Height in Feet.	Mean Annual Temperature.
Lund, .	57°	42′	60	45·10°
Wexiö, .	56	53	500	44·56
Göteborg,	57	42		46·34
Carlstad,	59	23	175	43·28
Stockholm,	59	20	125	42·2

The mean annual temperature of Edinburgh is close upon 47° Fahr., but the summer at these five places is several degrees warmer than at Edinburgh. The difference, however, between the greatest summer's heat and winter's cold is far more than is experienced in Great Britain. In Stockholm, for instance, the thermometer has marked 96·8° Fahr. in July, while in January of the same year the mercury had sunk to 26·6° below zero.

Of five places north of 60° N. lat. the mean annual temperatures are as follows:—

Place.	Lat.		Height in Feet.	Mean Annual Temperature.
Falun, .	60°	39′	400	39·92°
Hernösand,	62	38		36·36
Ostersund,	63	24	1050	35·80
Umea, .	63	50		35·42
Enontekis,	68	30	1440	27·04

The difference in the mean temperature of summer in these five places lies within 1°, though the most southern and the most northern are nearly 8° of latitude distant from one another, and the most northern is more than 1000 feet above the sea-level. This fact is to be attributed to the long stay of the sun above the horizon in that season, which, at Enontekis, lasts more than three weeks. But, on the other hand, the cold of winter in these parts is often so great that mercury freezes—a fact which indicates at least 40° Fahr. below zero. The longest day at Tornea is twenty-one and a half hours, the shortest only two and a half. In Stockholm the longest day is eighteen and a half hours, the shortest five hours fifty-four minutes.

Sweden cannot be said to have more than two seasons—winter and summer—which succeed each other with an interval of only a few days. Summer begins about the end of April, and continues till August or September. The winter lasts during all the other months of the year; the ground is then deeply covered with snow; and the rivers, canals, and lakes are frozen generally from October till April, or sometimes till May. The ice and snow melt very suddenly, and the leaves at once appear. In consequence of the heat vegetation is extremely rapid, so that north of the Arctic Circle barley has been sown and reaped in seven weeks. The long winter nights are cheered by the brilliant coruscations of the aurora borealis. In Swedish Lapland the summer lasts for fifty-six days, from the 23rd June till the 18th August, when the ground is again covered with snow and ice. After the snows have fallen and the winter has fairly set in, the climate, though so cold, is said to be very healthy, owing to the great elasticity and dryness of the air, which is generally pure, and there are no contagious diseases. The downfall of rain, snow, and hail is much less than in Norway, and appears to be scarcely one-fifth as heavy as in tropical lands, for in an average of thirty-six years it did not exceed 17½ inches annually. The winter is a busy season in the middle and north of the kingdom for the forest owner and farmer, and good sledging at this time is all-important to

the Swede who has any timber to get out of his forests, or iron ore to transport from the mines.

Produce, Agriculture, Forests, Minerals, &c.—The climate and the nature of the soil are unfavourable to the growth of grain, except in a few districts in the south. Great improvements are being made every year in the system of agriculture, and whereas previous to 1840 Sweden was obliged to import considerably more corn than the country produced, the export now exceeds the import. Wheat is very little grown, the principal produce being rye, barley, and oats. In the south rye is the most cultivated, in the north barley; the growth of the latter increasing in proportion as one proceeds further towards the pole, but the grains of all kinds are less nutritious and more difficult to preserve than those of the south of Europe. Oats seldom ripen north of lat. 63° 20′, but barley is grown almost to the limits of the pine woods in 69° lat. Hops and tobacco are cultivated up to 62°, and flax to 63° 30′. Next to grain the most important crop is potatoes—one of the main articles of food among the peasantry. The other products of the land are pease, clover, hemp, buckwheat, madder, woad, and nearly all the ordinary fruits and vegetables of western and northern Europe. Pears, apples, and plums grow in the open air in the south, but the grape, fig, apricot, and peach do not ripen except in hot houses. Melons, currants, gooseberries, cabbages, carrots, parsnips, and turnips thrive to 66° lat. A close sward of common grass is seldom seen, but docks, thistles, and other weeds are equally uncommon. The government does much to promote the scientific cultivation of agriculture, and excellent farming schools are established in every province, where peasants' sons are kept and educated in return for their work, the proprietors of the schools being subsidized by the state. Gentlemen pupils are also received, who pay for their board and education. All landed proprietors, and even the nobles, engage in agricultural operations, so that most of the estates are farmed by their owners. In those cases where they are large enough to require their assistance the labourers generally hold a small piece of land and a cottage at a fixed rent, which they do not pay in money, but by work. As a rule, however, the work is done by the owner and his family, for the farms are generally very small—the average of arable land to each throughout the entire kingdom being only about 30 acres. Pine, fir, and birch are occasionally found in the most northern parts, but the true forest-land must be considered as having its limit near 64°. Below this latitude, and chiefly in the central and southern parts of the kingdom, the forests occupy at least one-fourth of the whole surface, and sometimes stretch continuously for 80 miles in length by 20 miles in breadth. Many of them, however, consist of trees of stunted growth, available chiefly for domestic fuel, or the supply of the smelting furnaces, and are seldom of much use as timber. Forests in which oak and beech prevail occur only in the south. In the central parts the pines, firs, and birch are intermixed with ash, willow, linden, maple, and elm. As timber is the ordinary fuel of the country the consumption of firewood is enormous, and much has to be brought from Finland. Tar and pitch are extracted from the roots of the pine. Iceland moss, the food of the reindeer, and also of cattle, is very abundant.

The minerals include gold, now worked again after a long interval; silver, found in limited quantities in several places, particularly in Sala, in the län of Westeras, and the vicinity of Falun; copper, chiefly in the län of Falun, and smelted to a considerable extent at Stora-Kopparberg; cobalt, particularly in the län of Orebro; a little lead, and inexhaustible supplies of iron, distributed over nearly the whole of the country; the last, indeed, not only occurs in beds of immense thickness, inclosed in a strata of gneiss, but forms the principal mass of whole mountains. In Swedish Lapland the seams in some instances attain the immense thickness of 34 and 38 fathoms. Mount Taberg, to the south of Lake Wetter, on the table-land of Småland, forms another of the enormous mountain masses of iron; but the ore, though otherwise of good quality, contains only 25 per cent. of metal, and cannot be smelted to advantage with an intermixture of other ores. The most celebrated mines are those of Danemora, in the län of Upsala, where the iron worked is perhaps the best in the world, and being admirably adapted for steel, is in great demand for that purpose in England and the United States, where it commands a very high price. The annual produce, however, is only about 4000 tons. Much larger quantities, also of excellent quality, are produced in the läns of Falun, Gefle, Westeras, Carlstad, and Orebro. The other minerals of the country are zinc, manganese, sulphur, litharge, vitriol, alum, sulphate of iron, and a small quantity of coal of very inferior quality. Porphyry is found which will take a fine polish, and is made into a great number of articles of a very ornamental description. There are no salt beds nor brine springs, and the waters of the Baltic not being largely impregnated with salt, this necessary article is wholly imported.

Animals, Fisheries, &c.—The principal domestic animals are cattle, sheep, and reindeer. The last, which are kept in large herds by the Laplanders, supply them at once with food and clothing. The cattle are generally of a small breed, and are not possessed of valuable properties either for the butcher or the dairy. The sheep were formerly very inferior, and yielded only coarse wool, but of late attempts have been made in the south to cross the Swedish sheep with the merino, and with English, French, and Saxon breeds, which promise complete success. The horses are small, but very numerous in the south. There is an excellent breed in the Isle of Eland, only 4 feet high. North of 64° lat. the reindeer is the only domestic animal.

Among the larger wild animals the wolf and bear are found in the forests, and often commit great ravages. The latter animal is, however, becoming scarce. The fox, elk, reindeer, lynx, marten, otter, weasel, and ermine also inhabit the country. The lemming sometimes leaves its retired haunts and visits the cultivated parts in countless swarms, when it devours everything green in its way. In the hot summer of the north mosquitoes are almost as troublesome as in tropical countries. Whales and sea-calves are occasionally found in the Gulf of Bothnia, and the porpoise commits great ravages among the fish there. There are few hares, but an abundance of other kinds of game. The cock of the wood or capercailzie is a fine bird, larger and not very inferior to grouse. Partridges are plentiful, as are woodcocks and wild fowl. Eagles and falcons inhabit the cliffs, and the wild swan and eider are hunted for their down.

The fisheries are important, and form a considerable branch of industry. Herrings, which used to visit the coast of the Baltic in large shoals, have almost entirely disappeared, though large numbers of a fish resembling them, and called *strömings*, are taken along the east coast. The deep-sea fishery grounds are in the North Sea, the Scaw bank, off the north of Jutland, and the coasts of Aland and Gothland in the Baltic. Cod, ling, halibut, and coal-fish are the principal varieties caught. The mackerel, lobster, and oyster fisheries are not so valuable as formerly, but sturgeon, rays, soles, turbot, and pilchard are abundant. The rivers and lakes are well stocked with salmon, pike, trout, perch, and eels.

Manufactures and Commerce.—The trade of Sweden has received a great impetus since 1854 by the abolition of the old protective system and the extension of railways. There are, in fact, very few countries the industries of which have, in the same period of time, made such rapid strides as those of Sweden.

Mining is one of the most important of Swedish industries, especially that of iron. There are also large veins of coal, but no systematic working of them has as yet taken place. Sugar-refining is now carried out on an extensive scale.

The principal glass factory is at Bromes; Eskilstuna is the chief seat of the hardware and cutlery business, and the government fire-arms are made there. Shipbuilding and distilling form extensive branches of industry. Saltpetre, potash, and tar are among the secondary articles of manufacture.

The domestic manufactures of Sweden are important, as, owing to the long winter nights, during which most of the out-door occupations are necessarily suspended, there are great facilities for home work; and the peasantry not only supply themselves with most descriptions of agricultural implements and furniture, but with nearly all the coarse woollen, linen, and cotton goods required for their ordinary use.

Since the year 1861 the distilling of "Branvin," the common brandy of the country (distilled from grain, potatoes, and other esculent roots), has been taken under the control of the government. Formerly any private person could distil, and the consumption of brandy, among the lower classes especially, was very large. It was even used like money as a circulating medium, and the peasants exchanged the whole produce of their farms, rye and potatoes, for it. Though it is still too much sought after, the consumption has now much decreased, and more ale and beer is drunk than formerly.

The foreign trade is principally carried on with Great Britain, Russia, Holland, Hamburg, and Denmark. The chief ports are Gothenburg and Stockholm.

The exports consist almost entirely of raw produce, of which iron, grain, and timber are by far the most important articles. The imports comprise sugar, coffee, salt, wines, spirits, silk, wool, cotton, coal, and manufactured articles.

The commercial intercourse of Sweden with the United Kingdom in recent years was as follows:—

	Imports from Sweden into the United Kingdom.	Exports from United Kingdom to Sweden.
1884 . .	£7,518,822	£2,352,572
1885 . .	8,114,493	2,178,252
1886 . .	7,476,114	2,067,301

Nearly half of the exports from Sweden to the United Kingdom consists of timber, and more than one-fourth of grain, chiefly oats. The only other large item is iron. The exports from the United Kingdom consist chiefly of coal, iron and woollen manufactures, coffee, and raw cotton.

The commercial navy of Sweden, registered for foreign trade at the various ports of the kingdom, consists of 4000 vessels, with a tonnage of 520,000. Gothenburg and Stockholm are the principal ports, the former having the largest amount of shipping.

A special commission was, on the initiative of the Swedish government, appointed in 1869 to introduce the French monetary system into the Scandinavian countries. Interrupted at its outset by the war of 1870, it was only in 1872 that a new commission, consisting of delegates from Sweden, Norway, and Denmark, met at Copenhagen to decide upon the monetary system to be adopted for the three kingdoms. It was finally resolved to create a special monetary system for the three kingdoms, having decimal calculation and a gold standard as its basis. The new currency was introduced in 1875, its chief feature in Sweden being the crown, or rigsdaler, of 100 öre. Its approximate value is 1*s.* 1½*d.*, or about 18 rigsdaler to the pound sterling. Some steps were taken in 1876 with a view to the introduction of the metric system of weights and measures, and it will come into use in 1889.

Until about the year 1852 there was not a railway in Sweden, the principal part of the inland traffic and carriage being conveyed by water; and on account of its numerous lakes and rivers no country in Europe is better adapted for water carriage than Sweden. In 1863 the main line from Gothenburg to Stockholm was finished- 280 miles. Various branches are connected with this line—the total length of the railways open in 1887 being over 4000 miles. They have been chiefly constructed at the cost of the state, and although originally it was scarcely hoped the outlay would be financially remunerative, the great expansion of the trade and commerce of the country, to which the railways contributed in no small degree, rendered them so far successful that they have paid at the rate of 5 per cent. on the capital.

Telegraph wires are fixed all through the country, even up to Haparanda. Almost all the lines are state property. The post in Sweden is excellently conducted; one universal rate of postage is adopted throughout the whole country.

Constitution and Government.—The fundamental laws of the kingdom of Sweden are—(1) the constitution or *Regerings-Formens* of 6th June, 1809; (2) the law of royal succession of 26th September, 1810; and (3) the amended regulations for the formation of the Diet, adopted 8th December, 1865. According to these statutes the king must be a member of the Lutheran Church, and have sworn fealty to the laws of the land. His person is inviolable. He has the right to declare war and make peace, and grant pardon to condemned criminals. He nominates to all appointments, both military and civil; concludes foreign treaties, and has a right to preside in the supreme court of justice. The princes of the blood royal, however, are excluded from all civil employments. The king has an absolute veto against any decrees of the Diet, and possesses legislative power in matters of provincial administration and police. In all other respects the fountain of law is in the Diet. This Diet, or Parliament of the realm, consists of two chambers or estates, both elected by the people, but representing different interests. The First Chamber, or Upper House of Parliament, consists of one deputy for every 30,000 of the population. The election of the members takes place by the "landstings," or provincial representations—one in each of the twenty-four "läns," or governments, of the kingdom—and the municipal corporations of all the towns not represented in the landstings. All members of the First Chamber must be above thirty-five years of age, and must have possessed for at least three years previous to the election either landed property to the taxed value of 80,000 rixdollars mynt (£1150), or an annual income of £223. They are elected for the term of nine years, and obtain no payment for their services. The Second Chamber, or Lower House of Parliament, consists of one representative for every 10,000 of the population of towns with more than 10,000 inhabitants, and one representative for every rural district under 40,000 inhabitants, and two for every rural district of more than 40,000 inhabitants. All natives of Sweden aged twenty-one possessing real property to the taxed value of £56, or an annual income of £15, are electors; and all natives aged twenty-five, possessing the same qualifications, and making, moreover, public profession of the Protestant faith, may be elected for the Lower House of Parliament. The election is for the term of three years, and the members obtain salaries for their services at the rate of £67 for each session of four months, besides travelling expenses. The salaries and travelling expenses of the deputies are borne by the government, as well as the cost of elections; and the expenditure of any money for the latter purpose by the parliamentary candidates is forbidden under heavy penalties. The vote is by ballot, both in town and country.

The two Houses of Parliament assemble every year, voting the budget for the same period. All the legislative measures are prepared in committees, appointed every session immediately after meeting. The committees are six in number - namely (1) the constitutional committee, which maintains a surveillance over all constitutional questions, and consists of ten members of each of the two Houses of Parliament; (2) the state committee, which superintends the state expenditure, and consists of nine members of each house; (3) the subsidy committee, which is charged with the examination of all questions in which the aid of the state may be required; (4) the legislative committee, which takes cognizance of all matters connected with proposed alterations in civil, criminal, or ecclesiastical law; (5) the bank committee, which superintends all the affairs of that establishment; and (6) the committee on complaints and petitions, to which, in the first instance, all these are specially referred.

The Diet of the two Houses constitutes the chief legislative power in the kingdom. The executive is in the hands of the king, who acts under the advice of a council of state, composed of two responsible ministers and eight privy councillors. The ministers are those of justice and foreign affairs. The council of state attached to the ministry consists of five colleges or departments--namely, finance, interior, marine, war, and education.

All the members of the council of state, together with the ministers of state, are responsible for the acts of the government, individually and collectively. But it is left to the two ministers to express more directly the will of the sovereign; and to them likewise is intrusted the duty of bringing new and important measures before the Diet, on the rejection of which they are expected to resign. The action of the council of state being less direct, its members are not necessarily involved in ministerial changes. Connected with the council of state, though not responsible to either Parliament or the sovereign, are the chancellor of justice, who is at the head of the judicial organization of the kingdom, and the *Justitiæ Ombudsman*, or attorney-general, who has to extend a general supervision over all the courts of law, and to watch that the constitution is upheld in the elections to the Diet, and in respect of all the other rights and privileges of the Swedish people.

Revenue and Expenditure.—The national income is derived mainly from customs and excise duties, and from state railways, while the expenditure is under the chief heads of army, debt, and general administration. The following are the figures in recent years:—

	1875.	1877.	1886.
	£	£	£
Revenue, . .	4,150,869 ...	4,489,778 ...	4,575,250
Expenditure, .	3,951,636 ...	4,442,409 ...	"

Through the efforts of King Carl XIV.—formerly General Bernadotte—the whole public debt of Sweden was liquidated during the years 1819 to 1840. Subsequent events, however, brought about the creation of a new debt, the proceeds of which were in great part devoted to the establishment of a system of railways by the state. The amount owing in 1887 was about £12,000,000. All the loans are paid off gradually by means of a sinking fund. Though the kingdoms of Sweden and Norway are united, the administration of the two countries is entirely distinct.

Population, &c.—Sweden was one of the first countries of Europe in which a regular census was taken. At the suggestion of the Academy of Stockholm an enumeration took place in 1748, and it was repeated at first every third year, and after 1775, every fifth year. At present a census is taken every ten years, besides which there are annual estimates of the population based on the returns of births and deaths. Great pains are taken to insure the accuracy of the returns.

The following table gives the area and population of each of the twenty-four lans or governments into which the country is divided:—

Governments (Läns).	Area, English sq. miles.	Population, 1884.
Stockholm (City), . . .	13	205,129
Stockholm (Rural district), .	2,995	147,486
Upsala, ...	2,053	114,591
Södermanland, ...	2,631	149,420
Östergötland, ...	4.243	266,954
Jönköping, ...	4,464	197,392
Kronoberg, ...	3,811	167,806
Kalmar, ...	4,438	241,232
Gotland, ...	1,203	52,750
Blekinge, ...	1,164	139,897
Kristianstad, ...	2,507	227,233
Malmöhus, ...	1,847	354,042
Halland, ...	1,899	135,939
Gothenburg and Bohus, . .	1,952	271,604
Elfsborg, ...	4,948	282,812
Skaraborg, ...	3,307	254,433
Vermland, ...	7,346	260,244
Örebro, ...	3,521	181,613
Vestmanland, ...	2,623	130,311
Kopparberg, ...	11,421	192,611
Gefleborg, ...	7,418	187,931
Vesternorrland, ...	9,530	181,808
Jemtland, ...	19,593	90,631
Vesterbotten, ...	21,942	112,209
Norrbotten, ...	40,563	95,340
Lakes Venern, Vettern, &c.,	3,517	
Total, ...	170,979	4,643,128

There are only two towns with more than 50,000 inhabitants, namely, Stockholm, as above, and Gothenburg. Almost all the inhabitants of the kingdom, with the exception of 16,000 FINS and 6500 Laplanders [see LAPLAND], are of Teutonic origin, and preserve the original features of the race in great purity, particularly in the central and south provinces, where they are characterized by a tall, robust stature, light hair, blue eyes, and light complexions. They are active and enterprising, and manifest a marked predilection for scientific pursuits. In point of intelligence and education the industrial classes are not surpassed by any country in Europe. They are also extremely patriotic, industrious, and remarkably early risers. The peasantry are, as a rule, well clothed, well fed, well lodged, and have universally plenty of firing. To check the too-prevalent vice of intemperance the liquor trade is regulated as follows:—The two beverages in use in Sweden—brandy and beer—are made in the country. But the public-houses for the sale or consumption of beer are well inspected and numerous; the brandy shops for consumption on the premises are greatly restricted, pay a heavy license duty, and are under very strict regulations. A Permissive Act exists, by which a parish or town can either entirely prohibit the licensing of brandy shops in its environs or limit their number. No brandy is allowed to be sold on credit, or to persons who are intoxicated, or are under adult age. There are societies, as in Gothenburg, which farm the brandy shops of certain districts, and transform them into respectable and well-managed eating-houses, with excellent effect.

More than one-half of the population of Sweden are devoted to agricultural pursuits, and are owners of the land which they are cultivating. The nobility, about 2400 families, formerly enjoyed considerable privileges, but these

have nearly all been annulled. The most important—that of sitting unelected in the diet—was repealed in 1865. Swedish towns are in general only thinly inhabited, being left almost entirely to manufacturers and merchants. There are no beggars, and the simple, indeed almost patriarchal, hospitality of the natives is very marked, especially in the more isolated provinces.

Swedish peasants make excellent emigrants, for they can generally turn their hands to anything—growing their own flax, which the women weave into the household linen; building their own houses, and keeping them in repair; tanning the skins of their cattle and making shoes of them; constructing agricultural implements, and shoeing their own horses.

Army and Navy.—The military reforms introduced by the Swedish government in 1874 effected a complete change in the army organization which had prevailed in Sweden during the previous 200 years. The army formerly consisted of five distinct classes of troops—namely, the *Indelta* or national militia, paid and kept, not by the government, but by the landowners; the *Beraering* or conscription troops; the *Varfvade* or enlisted troops; the volunteers, first organized in 1861, by the spontaneous desire of the people at large; and the militia of Gothland, similar to, but independent of, the Indelta. The officers were not allowed any pay, but had to maintain themselves on the estates provided for them by the government out of the national property. The men in the ranks were mostly also unpaid, each man being provided with quarters, food, clothing, and arms by the peasants and landowners of the district in which he enlisted, on the principle that those not serving in the army should maintain those who did. The present system is very similar to the Prussian, being based on the principle of general liability to military service, though many exceptions are made in favour of sailors, manufacturers of arms, officials, only sons, &c. Those who are liable serve between the age of twenty and thirty-two—six years in the army and the rest of the time in the landwehr, then passing into the landsturm until forty. The government provides quarters, food, and pay for the army, but the landwehr find their own clothing. In the time of war the vacancies caused by losses in the ranks are filled in the first instance by men of the landwehr, the landsturm being employed in protecting the districts where they reside. Substitution is forbidden, and the number of troops made available by the new system amounts to upwards of 160,000. The coast is protected by the fortresses at Marstrand, Gothenburg, Carlscrona, and Stockholm, all of which, however, have but small garrisons. The navy of Sweden was entirely reorganized and reconstructed between 1866–70. It is now divided into two distinct parts, the first to serve as an ordinary fleet of war, for aggressive as well as defensive purposes, and the second to be stationary, and devoted to coast defence. The navy now consists of fifteen ironclads—five monitors and ten gunboats—twenty-five unarmoured steamers, eleven torpedo boats, thirteen sailing vessels, and ninety-one stationary vessels, gunboats, and floating batteries. The Swedes make excellent sailors, and great numbers are employed in British and American ships.

Religion and Education, Law and Literature.—The state religion is the Evangelical Lutheran. To this the whole population conforms, with the exception of a few Catholics and Jews. Sweden was for many years conspicuous in Protestant Europe for its intolerance, and the power of the clergy is still very great. In 1867 the Second Chamber unanimously accepted a proposal for the extension of the rights of dissenters, but it was defeated in the Upper Chamber. In 1869, however, the law which punished proselytism from the pure Lutheran-Evangelical Church with fines was repealed, but it was not until 1871 that, still in the face of some opposition, the regulations for securing greater liberty of conscience were promulgated by the king. Dissenting communities may now be established, secession from the state church is no longer forbidden, the children of mixed marriages need no longer be brought up in the Lutheran faith, and marriages may take place before civil officials or dissenting ministers. The Lutheran hierarchy consists of an archbishop and eleven bishops, under whom are provosts and rectors of parishes, in each of which there is a school. Education is compulsory and gratuitous. Every child from seven years old must be sent either to a primary gratuitous school or to a private certificated school, and there be kept for six or seven years, or until he or she has acquired a competent knowledge of reading, writing, arithmetic, the catechism, the history and geography of their own country, the rudiments of natural history, general history, and geography. A person must know how to read and must be able to say his catechism by heart or he will not be admitted to receive the sacrament; and whoever has not received the sacrament is not allowed to marry. This regulation will account for the almost universal acquaintance with the elements of knowledge among the Swedish peasantry. It is stated on authority that of every 1000 persons only one is unable to read. Sweden has two universities, Upsala and Lund. The number of grammar, technical, and industrial schools is considerable. The Archbishop of Upsala is chosen by the king, but the people nominate their own pastors. The salaries of the clergy, generally derived from church land, are very small. The income of the Archbishop of Upsala is only £1200, and that of the bishops about £600. There are many holidays, besides Sundays, in the course of the year, on which no work is done. Christmas, Easter, and Midsummer are very strictly observed. The Sabbath begins at 6 p.m. on Saturday, and ends at 6 p.m. on Sunday, after which dancing, drinking, and holiday games are indulged in.

The laws are good and equitable; those relating to landownership and mortgage are particularly simple and efficacious, and the criminal laws lean to the side of mercy. Executions are rare, but the treatment of criminals whose sentences of death are commuted is very severe. For ordinary prisoners, too, bread and water is a common fare, and the silent system is very strictly observed. Each province has its governor, and each town its burgomaster. Judges are appointed for every district, who hold a court or assize in the spring and autumn at different places in their districts, for the trial of civil and criminal cases. There are three supreme courts, which sit respectively at Stockholm, Jonkoping, and Christianstad. To each of these a number of secondary tribunals are subordinate.

The arts and sciences have been successfully cultivated in Sweden. The study of antiquities, natural history, and chemistry has attained a high degree of perfection. At Stockholm there is an opera, and at Gothenburg a large theatre.

History.—The early history of Sweden is shrouded in an atmosphere of legend and fable. When the light of truth first penetrates the darkness we find it occupied by two separate races, the Swedes in the north, and the Goths in the south. Though split into numerous independent tribes, all recognized a common sanctuary in the temple at Upsala; and the sacredness attached to this religious centre assisted the princes whose seat of government was at that capital in gradually subduing the independent chieftains. All Sweden seems to have been united under one sovereign in the person of Eric Edmundsen, of the Skioldunger dynasty, towards the end of the ninth century (890). At this time the Swedes were a nation of piratical sea-rovers, who harassed the shores of the Baltic with fire and sword. They were pagans, too, for though Ansgar had preached the religion of Christ as early as 829, it made no progress until the baptism of Olaf Skotkonung in 1000, nor indeed was it firmly established until

the destruction of the heathen temple at Upsala a century later. Olaf received his name of Lap-King (Skotkonung), because he was crowned king in his nurse's lap. He was the first king who took the style of the King of Sweden instead of that of King of Upsala. Churches and monasteries were founded by Eric the Saint (1155–60), who by means of missionaries, mostly English, converted the Fins to Christianity, by uniting the cross with the sword, and who planted in Finland several Swedish colonies. This able and zealous monarch was murdered in 1160 by a Danish prince, named Magnus Henriksen, and a period of intestine convulsion followed, of strife and murder and rapine. Charles, the successor of Eric the Saint, obtained the erection of Upsala into an independent archbishopric, thus freeing his country from its ecclesiastical dependence upon the Danish see of Lund; but the remaining sovereigns of his line can hardly be said to have contributed much towards the advancement of their country, and it was reserved for a new dynasty to carry on the work of the earlier kings.

House of the Folkungas.—This powerful family had risen near the throne, and while retaining their tribal rank of Jarls, had come to fulfil the functions of mayors of the palace. Eric Ericsen died without heirs in 1250, and the vacant throne was conferred upon an infant of the great family, his father, Birger Jarl, acting as regent for him (1250–66). Birger was the grandest figure in the north of his day. He founded Stockholm (1254), he conquered and annexed Finland, protected the exiled princes of Russia, and controlled both Norway and Denmark. The conquest of Finland was thoroughly completed by Tarkel Knutsen at the close of the thirteenth century, in King Birger's reign (1290–1319), but this was the last great achievement of the dynasty. Domestic quarrels sprang up, and the weakness thus entailed upon the country left it unable to cope with the disaster of an unsuccessful expedition against Russia, and with the plague, which fell with full force upon this unhappy land (1348). In the midst of these calamities, which were all attributed to the badness of their rule, some with justice and some quite without reason, the house of the Folkungas fell—its last princes were banished 1363.

Albert, duke of Mecklenburg, was elected successor to the hated Folkungas (1363); but he soon had a formidable rival in Margaret, widow of the Swedish Hakon, king of Norway, and a Folkunga; in fact, Hakon was the son of the last king of the banished line of Sweden. Margaret had secured the election of her son Olaf to the throne of Denmark in 1375, and his father's death in 1380 made him king of Norway also, as well as claimant to his grandfather's crown of Sweden. Margaret ruled all in his name; and at his death, in 1387, she was accepted as queen regnant. She next formally claimed the crown of Sweden. A sharp war ended in the defeat and capture of King Albert, and the Swedish Diet at once offered Margaret the crown. She, however, preferred her nephew Eric, already acknowledged as her successor in Norway and Denmark, to be titular king, and at a solemn meeting of the states at Calmar (the famous *Union of Calmar*), in 1397, Eric was crowned sovereign of the three kingdoms. The union rested, however, practically upon Margaret's wise conduct. She was called the Semiramis of the north, and ruled most nobly the federation she had called into being. She was, however, quite unable to effect real union. Not one of the three kingdoms would abate a tittle of its independence, or part with one of its privileges. Even the crown was elective—for in the event of there being more than one son in the royal family, it was stipulated that each country should be free to elect its king from the whole number of princes. On Margaret's death, in 1412, the differences she so long had concealed at once broke out. Insurrection followed insurrection during the reigns of the five princes who held the three crowns. A peasant named Engelbrecht led the Swedes to revolt in 1434, in consequence of the failures of the king in war, the heavy taxation, and the prevalence of Danish authority. The revolt was put down, but broke out again under Karl Knutsen, and this time the Norwegians joined the movement. Finally, the Danes agreed to depose Eric (1439), and the nephew of the great Margaret ended his days as a mere pirate on the shores of the lands where he had once reigned. His nephew Christopher III. succeeded him, and by wise concessions maintained something like order; in fact the death of Christopher without heirs, in 1448, was a great misfortune for the countries.

Sweden now elected Karl Knutsen king, and Norway also accepted him. He could not really retain the crown, but he was just strong enough to keep Christian I. of Denmark from having any real authority in Sweden. His nephew Sten Sture succeeded him, and the son and grandson of this chief were able to defy the King of Denmark, and to rule Sweden in virtual independence under the style of Administrators. Norway, on the other hand, was soon crushed by Denmark.

In 1520 Christian II. of Denmark restored the Danish supremacy over Sweden, but only for a few years. His tyranny stimulated against him the national hatred. Even during the ceremony of his coronation he caused ninety-four Swedish noblemen to be beheaded in the market-place at Stockholm. His cruelties so exasperated his subjects that, as was said, "the Union of Calmar was drowned in the blood bath of Stockholm." They needed but a leader to break out into open revolt, and in the young Gustaf Ericsen of Vasa they found one worthy of their implicit confidence and devotion. Under his guidance they threw off the Danish yoke; and in reward they elected him king. His rule was distinguished by firmness, moderation, and ability. He replenished the treasury, developed the national resources, fostered trade and commerce, established the Reformed Church in close connection with the state, limited the power of the nobles, improved the administration of justice, organized a standing army, and equipped a small but efficient naval force. He also rendered the crown hereditary in his own family. If in this respect he gratified his personal ambition, in all other points he sedulously consulted the interests of his country, and Sweden should regard the memory of Gustaf Vasa with as much reverence and affection as Russia shows for that of Peter the Great. Both were more than kings; they were founders, and representative men.

Gustaf died in 1560. His son and successor, Eric XIV., whose bright, keen intellect was prematurely clouded by insanity, did much towards undoing his father's great work, but he was deposed in 1568. His younger brother, John, who then ascended the throne, endeavoured to extirpate Protestantism and force Popery upon his reluctant subjects. In this wild project he was followed by his son Sigismund, who was also King of Poland; and Sweden, beset by foreign enemies and distracted by internal feuds, counted some disastrous pages in her history, until the patriotism of the Diet proved equal to the crisis, compelled Sigismund to abdicate, and placed the crown on the brow of Charles IX., the ablest and most honest of Gustaf Vasa's sons. Under his wise and far-seeing rule Sweden recovered her prosperity at home and her influence abroad. It became his policy, as it was that of the English Tudors and Louis XI. of France, to reduce the power and abate the exorbitant pretensions of the nobles, while encouraging the growth of the commercial or citizen classes.

GUSTAVUS ADOLPHUS succeeded his father in 1611. A devout, God-fearing, earnest-minded prince, he won a world-wide fame by his crusade against Popery. At the commencement of his reign he found himself involved in hostilities with Poland, Denmark, and Russia; but from

these he was extricated by the genius of his great minister, OXENSTIERNA, who also reorganized the internal administration of the kingdom. Gustavus then espoused the cause of the Protestant princes of Germany, who were threatened by Austria and Spain with total destruction. Supported openly or secretly by England and France, he landed in Germany with a small but thoroughly disciplined army, and inflicted a succession of severe defeats on the imperialist leaders. His victories gained him the title of the "Lion of the North," but his career was abruptly terminated by a musket shot at Lutzen in 1632. See THIRTY YEARS' WAR.

His daughter, Christina, was only six years old when thus suddenly called to the throne. During her minority Sweden was ruled by Oxenstierna with extraordinary vigour and success, and his able generals fully maintained the military prestige which Sweden had secured under Gustavus Adolphus. Her territories were increased by the annexation of Jemptland, the islands of Gothland and Oeland, and on the Continent Mecklenburg, Upper Pomerania, Bremen, Werden, and Wismar. CHRISTINA had a touch of madness in her nature, and though not devoid of ability, she undoubtedly rendered her subjects the greatest possible service by abdicating, in 1654, in favour of her cousin Charles Gustavus (Charles X.) In 1660 this king, whose reign was brilliant with feats of arms, and who added the three Danish provinces of Halland, Scania, and Blekinge permanently to Sweden, was succeeded by his youthful son, Charles XI., whose long minority had no evil influence on the fortunes of his kingdom, through the exertions of his wise and patriotic ministers. In his reign the prerogatives of the crown were largely extended, and he bequeathed almost despotic power to his son, CHARLES XII. (1697–1718), whose brilliant but chequered career, from the victory of Varna to the disastrous defeat at POLTAVA, where his whole army was cut off or made prisoners by the Russians under PETER THE GREAT; whose captivity at Bender, in Turkey, romantic escape, and death by a cannon-ball at the siege of Fredericshall, in Norway —have so often furnished the moralist with a pregnant illustration of the follies, evils, and misfortunes of ambition. Who does not remember Johnson's well-known lines?—

> "He comes—nor want, nor cold his course delay;
> Hide, blushing glory, hide Poltava's day:
> The vanquish'd hero leaves his broken bands,
> And shows his miseries in distant lands;
> Condemn'd a needy suppliant to wait,
> While ladies interpose and slaves debate.
> But did not chance at length her error mend?
> Did no subverted empire mark his end?
> Did rival monarchs give the fatal wound?
> Or hostile millions press him to the ground?
> His name was destin'd to a barren strand,
> A petty fortress, and a dubious hand;
> He left a name at which the world grew pale,
> To point a moral or adorn a tale."

With Charles XII. terminated the male line of the Vasas, and the place held by Sweden as a leading European power for a full century. Charles' brilliant follies cost Sweden all her continental possessions. The King of England (Elector of Hanover) purchased Bremen and Werden from the Danes who had conquered them, Pomerania fell to Prussia and her allies, Finland, Livonia, and Carelia to Russia. His sister, Ulrica Eleonora, ascended the throne, by the free election of the states, but she was constrained to resign all pretensions to absolute power, and in 1720 transferred the government to her husband, Frederick, hereditary prince of Hesse-Cassel. Their reign was disturbed by the feuds of two hostile factions, the "Hats," or French party, and the "Caps," or Russian, neither of whom consulted the true interests of their country. In 1751 Adolphus Frederick, duke of Holstein and bishop of Lübeck, was called to the throne, and married Louisa Ulrica, sister of the King of Prussia. He was weak and incapable; his reign was disturbed by the quarrels of faction; and Sweden made little real progress in material prosperity.

It seems necessary here to consider the new form of government established at this juncture, with the view of limiting the authority of the crown—in which it succeeded, without, however, establishing a government that had any elements of solidity. It was declared that the supreme legislative authority henceforth resided solely and absolutely in the states of the realm assembled in Diet, that the assembly must take place once in three years, and that the Diet could only be dissolved by its own consent. When the Diet was not sitting, the executive power was vested in the king and senate; but, bound in all affairs of state to abide by the opinion of the majority, and in possession of but two votes, the casting voice in event of equal suffrages, the king became entirely a subordinate, and could only be considered as the president of the assembly. At the same time, the senate was dependent on the states; since its members, though nominally appointed for life, were amenable to that body, and liable to be removed from their offices in case of real or simulated malversation. The supreme authority was thus vested in a tumultuous assembly, composed of the four orders, to which the most penniless nobles, the meanest tradesmen, and the lowest peasants were admitted. All statutes were signed by the king, and all ordinances issued in his name, but in neither case did he possess a negative. And, lest at any time he might attempt to exercise this privilege, it was enacted in the Diet of 1756, that "in all affairs, without exception, which had hitherto required the sign manual, his majesty's name might be affixed by a stamp, whenever he should have declined his signature at the first or second request of the senate." Consequently, the royal signature was actually engraved, and was applied to the ordinary despatches of government, under the supervision of the senate. In a word, the king enjoyed little more than the mere name of royalty: of power he had none; and he became, in fact, the ostensible instrument in the hands of the two great parties which alternately achieved power in the Diet. Fully determined to wrest from the senate their assumed prerogatives, and to recover something more than the semblance of authority, the king proceeded to take a bold and decisive measure. On the 13th of December, 1768, he signed a declaration by which he formally abdicated the crown of Sweden; and by publishing this act throughout the kingdom he at once suspended all the functions of government. The senate felt their authority insufficient to counteract so momentous a measure; for their orders were disputed by all the colleges of state, who had ceased to transact the business of their several departments. Agreeably to the form of government, the magistrates of Stockholm proceeded to convoke the order of "burghers," which compelled the senate to consent to the desired assembly of the Diet; and on concurring with the request that he should confirm the proclamation for that purpose, the king resumed the royal authority. At the meeting of the Diet which took place on the 19th of April, 1769, a compromise was effected, which, though it coincided in some particulars with the king's views, was far from effecting the requisite ends.

Adolphus Frederick died 12th February, 1771, and was succeeded by his eldest son GUSTAVUS III., then twenty-five years of age. He was a prince of extraordinary capacity, but of a dissolute and insincere character. By a series of subtly devised measures he crushed the arbitrary power of the senate, and enlisted the great body of the people in support of the more extended authority of the crown. His policy was favourable to the development of the national resources, but his energy and his personal vices combined to create a number of enemies, by whose

instrumentality he was assassinated on the 16th of March, 1792, being shot while at a masked ball by an officer named Ankarstroem. The wound proved mortal, and the king expired in great agony on the 29th, nominating his brother, the Duke of Sudermania, to the regency during the minority of his son Gustavus IV.

The next reign proved disastrous. Incapable of a firm policy, Gustavus IV. courted in turn the alliance of France, England, and Russia, and proving faithful to neither, incurred the hostility of all. His war with Russia involved Sweden in the utmost peril. The courage of her armies availed nothing against the overwhelming forces of the Russians, and to save the country from total ruin Gustavus was arrested and deposed, and his uncle raised to the throne under the title of Charles XIII. (1809). He immediately concluded peace with Russia, but was compelled to sacrifice all claim to Finland to the ambition of the great Muscovite power, and to sell Pomerania (which had been restored to Sweden) to Prussia, in order to meet financial needs.

The reign of Charles, who was childless, was vexed by a series of domestic intrigues, which resulted in the nomination of the French General BERNADOTTE, one of Napoleon's ablest but least trusted soldiers, as crown prince and heir presumptive to the crown (1810). It was supposed that his election would have gratified the French emperor, whose overweening jealousy, however, regarded with unfavourable eyes the elevation of a possible rival, and Bernadotte soon showed that he had no intention of becoming his instrument, or of sacrificing the interests of his adopted country to the selfish schemes of imperial aggrandizement. Under his influence Sweden joined the allies in their opposition to the French emperor's projects of conquest, and received as a recompense, in 1814, the important addition of Norway to her territories.

Bernadotte became king in 1818, with the title of Charles XIV. His administration was prudent and sagacious. He confirmed Norway in the enjoyment of her national rights and privileges, and settled the administration of both countries on a firm and enlightened basis, which has continued to serve till the present day. A viceroy or governor-general resid s at Christiania; the revenue and armies of both countries are kept distinct; and Norway enjoys her own separate parliament.

His liberal policy was adopted and continued by his son Oscar (1844 59), and the Bernadotte dynasty was firmly established in the affections of its subjects.

Oscar was succeeded by Charles XV., born 3rd May, 1826, who visited England in 1861. Under his auspices the doctrine of free trade was adopted on the 1st of January, 1864; and in December of the same year a National Scandinavian Society was formed at Stockholm, with the view of securing, by legal means, a confederation of the three Scandinavian kingdoms, Norway, Sweden, and Denmark, for military nd foreign affairs, while reserving to each its independent administration. In 1865 the reform of the representative system of the country, which had been pending for at least 100 years, was carried into effect. During this reign railways were introduced and the absurd laws which fettered religious liberty were greatly relaxed. Charles XV. died in September, 1872, and as the law of Sweden excludes women from the throne, he was succeeded by his brother, King Oscar II.

Kings of Sweden.—Olaf Skotkonung succeeds Eric Edmundsen about 1000 A.D., and establishes Christian faith: Anund Jacob, 1026: Edmund Slemme defeated and killed by Goths, 1056: Stenkil then rules over Goths and Swedes, 1056: Inge the Pious (1079) burns heathen temple of Upsala, dies 1112. Interregnum.

Sverker, 1129: Eric IX. (St.), 1155, conquest of Finland, 1154: Carl VII. (son of Sverker), 1162, defeated and killed by Cnut (son of Eric), who succeeded, 1168: Sverker II. (son of Cnut), 1192, defeated and killed by his brother, Eric X. (Cnutsen), 1210, who succeeded: John I. (Sverkersen, nephew), 1220: Eric XI. (Ericsen, cousin), 1223, died childless.

The Folkungas.—Waldemar (nephew of Eric XI. and son of Birger Jarl, mayor of palace), 1250; Stockholm founded: Magnus I. (brother), 1279: Birger II. (son), 1290: Magnus II. (nephew), 1320, deposed 1363, and succeeded by Albert of Mecklenburg.

The Union.—Margaret of Denmark (regent), 1389, having defeated Albert; union of the three crowns of Denmark, Sweden, and Norway at Colmar, 1397: Eric XIII. (nephew of Margaret), 1412; Insurrection of Engelbrecht, 1434: Christopher of Bavaria, 1441; Charles VIII., 1448; Sten Sture administrator, 1470, Sweden practically autonomous: John II., 1483; Svante Nilson Sture administrator, 1503; Sten Stúre II. administrator, 1512: Christian II., 1520.

Line of Vasa.—Gustaf Vasa, 1523; Lutheranism adopted by Diet of Westeraas, 1528: Eric XIV. (son), 1560: John III. (brother), 1568: Sigismund (son, also king of Poland), 1592: Charles IX. (brother), 1604: Gustavus Adolphus (son), 1611: Christina (daughter), 1633, abdicated: Charles X. (cousin), 1654: Charles XI. (son), 1660: Charles XII. (son), 1697, battle of Poltava, 1709: Ulrica Eleonora (sister) and her husband Frederick of Hesse-Cassel, 1720, died childless.

House of Holstein.—Adolphus Frederick of Holstein Entin, elected at bidding of Russia, 1751: Gustavus III. (son), 1771, assassinated: Gustavus IV. (Adolphus, son), 1792: Charles XIII. (brother), 1809; constitution established, 1809; succession to the throne regulated, 1810; union with Norway, 1814.

House of Bernadotte.—Charles XIV. (Bernadotte), 1818: Oscar I. (son), 1844: Charles XV. (son), 1859: Oscar II. (brother), 1872.

LANGUAGE AND LITERATURE.—The Swedish is one of the Scandinavian tongues, and as such belongs to the Germanic (or Teutonic) branch of the family of the Indo-European languages. Though Old Norse proper was the speech of the whole Scandinavian peninsula and of Denmark until the eleventh century, its dialects varied considerably even in the most primitive times, and out of one or more of those ancient dialects modern Swedish was developed. The change was so slow that the Icelandic lays and sagas were still understood at the Swedish court as late as the fourteenth century. In its earlier stages Swedish was influenced by German through the commercial connection of Sweden with the Hanseatic towns, by the Latin through the Catholic priesthood and the monastic institutions, and by Danish through the political union of Sweden and Denmark subsequent to the pact of Calmar (1397). The Reformation again subjected it to German influences. The language was greatly purified and a multitude of foreign vocables driven out by the efforts of the zealous Icelandic scholars of the latter half of the seventeenth and the first quarter of the eighteenth century. But later in the last century the French tastes prevalent at the court and in the literature introduced a large number of Gallic words, many of which, however, have been since superseded by genuine Scandinavian derivatives. Several dialects are now spoken. In the northern provinces the approximation to the Old Norse or Icelandic forms is much more marked than in the southern, where Danish and German influences have been felt; the southern dialects of Scania and Blekinge have great similarity to Danish, and that of Dalecarlia presents the greatest departure from the written language, while that of Sodermanland approaches it the nearest. Swedish is also the language of the educated classes and partly of the press in the Russian grand-duchy of Finland.

The Swedish alphabet has twenty-eight letters, the same as in English, with the omission of *w* (in Swedish formerly

the equivalent of *v*, by which it is now generally replaced) and the addition of *a*, *ä*, *ö*. Formerly the German character was mostly used in Swedish works, but now the Latin character prevails, though the former is still sometimes to be found. A letter peculiar to the Swedish is *å*, which is pronounced almost like the English *o* in *note*. The vowels *a*, *e*, *i*, *ä*, and *ö* are pronounced as in German; *o* has two sounds, either similar to that of the English *o* in *more*, but intermediate between *o* and *u*, or equivalent to the English *a* in *fall*. The sound of *u* is intermediate between the German *u* and *ü*. *Y* is pronounced almost like the German *u*. *G* before *e*, *i*, *y*, *ä*, *ö* has a sound like the English *y* in *you*. *J* has the same sound. *D*, *g*, *h*, and *l* before *j*, and *h* and *f* before *v*, are mute. *K* before *e*, *i*, *y*, *ä*, *ö* is soft and pronounced like *ch* in *much*. *Sk* before the same letters and the combinations *skj*, *sj*, *stj* are pronounced like the English *sh*. Among the best grammars of the language are those of Rydqvist, "Svenska Sprakets Lagar" (four vols., Stockholm, 1850–73); Stromborg, "Svensk Spraklara" (Stockholm, 1858); and May, "A Practical Grammar of the Swedish Language" (fourth edition, Stockholm, 1873). Among the best lexicons are Dalin's (two vols., Stockholm, 1850–54), and especially Kinblad's (three vols., Stockholm, 1840–73).

The literary history of Sweden has been very conveniently divided into six periods.

1. 1250 to 1520.—The earliest writings extant in the Swedish language are the ancient provincial laws, of which the oldest compilation, that of the province of Westergotland, was probably made about the middle of the thirteenth century. The poetical spirit of the nation was first developed in the *Kampavisor* or heroic ballads, and a little later in the *Riddarvisor* or chivalric ballads. Of these several collections have been edited; a few of them may perhaps be ascribed to the latter part of the thirteenth century, but the greater part of them belong to the fourteenth and fifteenth centuries. Of greater influence upon the written language were the romances of chivalry, mostly translations and imitations of those then popular in Central Europe. As many of them were translated between 1300 and 1312 by order of Euphemia, queen of Norway, they are collectively called "Drottning Euphemias Visor" (Queen Euphemia's Songs), though many are in prose. The most noteworthy productions of the fourteenth century are "De stora och de gamla Kronikarna" (The Great and the Old Chronicles), narrating the leading events of Swedish history. The literary monuments of the fifteenth century are principally the Codex Vadstenensis, a collection of legends, essays, letters, and diaries, made by the nuns and monks of Wadstena; an anonymous judicial treatise, "Domarereglorna" (Rules for Judges), and a curious political work, "Om Konunga-och Hofdinga-styrelsen" (On the Government of Kings and Rulers), based upon the book of an obscure Latin author, Ægidius Romanus. Printing was introduced into Stockholm in 1483, the first book printed being a collection of fables styled "Dialogus Creaturarum Moralisatus."

2. 1520 to 1600.—The religious contests of the sixteenth century gave a theological or rather polemical character to almost the entire literature.

3. 1600 to 1718.—The learned foreigners who flocked to the court of Christina, among them Descartes, Bochart, the younger Heinsius, Gronovius, Pufendorf, and Scheffer, gave an impetus to higher culture in Sweden, but as they wrote in Latin they did little for the development of the vernacular literature. The investigations of the Icelandic literary monuments by Olof Verelius (1618–82), Olof Rudbeck (1630–1702), and Johan Peringskjold (1654–1720), causing the publication of Icelandic texts, principally the Eddas, were of more importance in this respect. The historical writings of Eric Tegel (died 1638), A. Girs (died 1639), Widekindi (1620–97), Werwing (died 1697), and Adlerfeldt (1671–1709) exhibit a considerable improvement in the use of language, though they can hardly claim to be much more than heavy compilations of facts and materials. But the progress made in the literary use of the vernacular is almost wholly due to the few who attempted romance and poetry. In poetry Georg Stjernhjelm (1598–1672) held the foremost place. His most complete poetical work is "Hercules," a sort of didactic epic in hexameters, exhibiting large imaginative power and much poetic skill. Stjernhjelm was the first [illegible]

surrounded by a crowd of pupils, a large number of whom became celebrated; among them P. Forskal (1736–63), who undertook a scientific journey to Egypt and Arabia, and whose researches were published by Niebuhr, and C. Bjerkander and J. G. Wahlbom, who illustrated the flora of northern Europe. P. Artedi (1705–35) wrote a treatise on ichthyology, which Linnæus edited in 1738. To physiology belong the "Œconomia Regni Animalis" and "Regnum Animale" of Swedenborg (1688–1772). The entomological works of C. F. de Geer (1720–78), in French, are still esteemed. Eminent in chemistry were Torbern Olof Bergman (1735–84), who laid the foundation for the science of crystallography; A. F. Cronstedt (1722–65), the discoverer of nickel; and J. G. Wallerius (1709–85). Much attention was paid to mining by M. von Bromel (1679–1731), Swedenborg, and others. Olof Rudbeck the younger (died 1740) distinguished himself in several sciences; he published among others a work on ornithology in three volumes. N. Rosen von Rosenstein (died 1773) was the reformer of medical science in Sweden. Astronomy was illustrated by such names as A. Celsius (1701–44), inventor of the centigrade thermometer; S. Klingenstjerna (1689–1785), and P. W. Wargentin (1717–83): mechanics by C. Polhem (1661–1751) and Swedenborg: and mathematics by J. Faggot, C. Falkengren, E. O. Runeberg, and others. Theology produced no very eminent man except Swedenborg. [See SWEDENBORG.] Johan Ihre (1707–80) won fame by his "Glossarium Sveo-Gothicum," a Swedish dialect lexicon, and by his researches concerning Ulfilas and the Mœso Gothic language. In history, as in polite literature, Olof Dalin (1708–63) stands at the head of this period. His journal *Den Svenska Argus* (The Swedish Argus, 1732–34), an imitation of the English *Spectator*, exerted a weighty influence upon the prose style of the language and the literary taste of the nation; and his "Svea Rikes Historia" (History of the Swedish Realm), though wanting in critical ability, is eloquent and pleasing. The history of Charles XII. by G. Norberg (1677–1744), and the "Memoirs of Christina," by J. Arckenholtz, written in French, have been of great assistance to succeeding writers. O. Celsius the younger (1716–94) wrote histories of the reigns of Gustavus Vasa and Eric XIV., and rendered a great service to Swedish letters by establishing the *Tidningar om de Lardes Arbeten* (Journal of the Works of the Learned), the first critical periodical in the language. Subsequent to the time of Dalin the dramatic compositions were lifeless imitations of Gallic prototypes. Such was the case too with the tedious romances of J. H. Mork (1714–63), the first Swedish novelist. Mol..., Voltaire, Boileau, La Fontaine, Marmontel, and Fénélon were translated and sedulously imitated.

5. 1772 to 1809.—The earlier portion of this period took its impress to a great extent from the character of the sovereign, Gustavus III. His influence was not beneficial to the higher walks of literature, but he founded the Swedish Academy of Eighteen (1786), and otherwise sought to encourage letters. The pupils of Linnæus con-

tinued to be the chief scientific men of the time, and laboured earnestly for the advancement of science. As chemists and mineralogists, the period furnished C. V. Scheele (1742–86), regarded as one of the founders of organic chemistry, and J. G. Gahn (died 1818), to whom several chemical discoveries are due. Sven Lagerbring's "Svea Rikes Historia," though often inaccurate, was looked upon as a national work by his contemporaries, and its author was richly rewarded by the Swedish estates. His other writings are numerous. Under the direct influence of Gustavus III. the French taste now became almost entirely prevalent. Gustavus himself wrote some dramatic pieces of much merit, but all frigidly French. The favourite poets of his court were Kellgren, Leopold, and Oxenstjerna. The lyrics of M. Choræus (1771–1806), the "Spastara" and "Medea" of B. Lidner (1759–93), the poet of the passions, and the translations from Virgil, Horace, and Ovid, by G. G. Adlerbeth (1751–1818), are still read with pleasure. A few poets escaped the general contagion. Foremost among these was Carl Michael Bellman (1740–95), a song writer of the highest powers, who set his songs to appropriate melodies himself. Two of his friends, C. I. Hallman (1732–1800) and O. Kexel (1748 96), were comic dramatic writers of worth. The last years of this period, comprising the reign of Gustavus IV., exhibited little literary life. Freedom of the press was abolished in 1798. and a systematic censorship enforced. The Swedish academy was suspended for some months in 1795. Thorild was banished, Leopold was ordered away from the capital, and Höijer was not allowed to write.

6. 1809 to the present time.—With the political revolution of 1809 the literature of Sweden was endowed with a new spirit, and greatly developed by a general use of the vernacular instead of Latin or French. Schools have largely improved both in number and character, and libraries have increased. The chemist Johan Jakob Berzelius (1779–1848) was a luminary of the scientific world scarcely less lustrous than Linnæus. [See BERZELIUS.] As botanists the reputation of three men has extended beyond their native land: Elias Fries (born 1794), K. A. Agardh (1785–1859), and G. Wahlenberg (1780–1851). A geologist of great note was A. J. Erdman (died 1869). Zoology has a famous cultivator in Sven Nilsson, also the author of ethnographical and antiquarian works, which have exercised a lasting influence on archæological studies. In entomology there are C. G. Thomsson, whose "Skandinaviens Coleoptera" (1857–70) is well known, and T. Thorell, author of a valuable work on European spiders. The chief labourer in ornithology, besides Nilsson, has been C. J. Sundevall (died 1875). Sweden has a native philosophical school, whose founder, C. J. Bostrom (died 1866), developed the most purely idealistic system that has appeared. The Bostromian philosophy has been ably expounded by G. Nyblæus in a most important work on the history of Swedish philosophy (1873). C. D. Arfwedsson and N. J. Andersson are prominent names in the literature of travels; and of late C. W. Paijkull (died 1872), by his account of Iceland, and A. E. Nordenskjold, by his arctic researches, have gained an extended reputation. The study of Icelandic and its literature has been promoted by the labours of Afzelius and his successors. In Swedish history the first place is due to Eric Gustaf Geijer (1783–1847), whose works are models of historic composition. Anders Fryxell (born 1795) and Strinnholm also rank high as historians. But the most eminent historian of Sweden was undoubtedly the last of this great school, Fredrik Ferd. Carlsson (1811–1887), scarcely less prominent as a statesman than as a man of letters. He was tutor to the sons of King Oscar I., and professor of history at Upsala. His history began with two volumes on the kings of the "Palatinate House," which were published in 1855, and at once placed him at the head of historical writers in Sweden. Not only so, but an historical school grouped itself round him, and from this all the best of the later work has sprung. From 1862 to 1870 Carlson was a minister of state. The "Biographisk Lexikon," a biographical dictionary of celebrated Swedes, edited by Palmblad, and subsequently by Wieselgren, is in twenty-five volumes. This is the brightest age in the annals of Swedish poetry. F. M. Franzen (1772–1847) has gained a lasting renown by his naive and idyllic lyrics. J. O. Wallin (1779–1839) revised in 1819 the Swedish psalm-book, a collection of religious verse hardly excelled in modern hymnology, and added 117 psalms by himself and 73 by Franzen, inferior to none in the book. Two new poetic schools, of vast influence upon polite literature, arose at the beginning of this period, the romantic and the Gothic. The former was represented by the journal *Fosforos*, whence its members are sometimes styled Fosforister or Phosphorists. At the head of this school stood P. D. A. Atterbom (1790–1855) as a poet, and Palmblad and Hammarskold as critics. Atterbom's long poem, "Lycksalighetens O" (The Island of Bliss), his "Blommorna" (The Flowers), and many of his shorter lyrics, are characterized by depth of fancy and feeling. Another Phosphorist was C. F. Dahlgren (1791–1844), author of "Mollbergs Epistlar," an imitation of the songs of Bellman; and a sort of Swedish Sterne is found in Dr. Aval Munthe, whose account of his noble journey of succour to plague-stricken Naples in 1884 was translated into English in 1887, and well rewarded the toil of the translator. C. E. Fahlcrantz (1790–1866) is a successful humorist in his "Noah's Ark," but less happy in his religious epic, "Ansgarius." The Gothic school, which has left a permanent impress upon poetry, sought its sources of inspiration in the ancient literature and mythology of the North. Foremost among its members stands Esaias Tegner (1782–1846), whose "Frithiof's Saga," based upon the Icelandic sagas, has been translated into many languages. Tragedies and historical dramas have been written by J. Börjesson (1790–1866), whose "Eric XIV." is one of the masterpieces of the Swedish drama. No romances stand higher than those of Fredrika Bremer (died 1865), whose works are widely known in other countries through numerous translations. Most of the higher efforts of literature in English, French, German, Italian, and Danish have been translated into Swedish in recent years. Sweden supports nearly 300 newspapers, one of which, *Svenska Veckobladet*, has a circulation of over 50,000 copies.

SWEDENBORG, EMANUEL, a celebrated Swedish philosopher and mystic, was born in Stockholm, 29th January, 1688. He was the eldest son of Jesper Svedberg, then pastor of Vingaber, and afterwards bishop of Skara, his mother being Sara Behm, daughter of Albrecht Behm, assessor of the Royal College of Mines in Sweden. The bishop bestowed great care on the education of his son, and at the University of Upsala he studied the learned languages, mathematics, and natural philosophy, taking there his degree of Doctor of Philosophy in 1709. He afterwards travelled for two years in England, Holland, and France, and made a further stay at Greifswald, in Pomerania, before returning to Sweden. During this period he published some fables and poems in Latin, and after his return to Sweden he issued a few numbers of a periodical devoted to mathematics and mechanics. In 1716, through the good offices of his friend Christopher Polhem, an eminent engineer, he was introduced to Charles XII., who appointed him assessor-extraordinary of the College of Mines, and associate engineer with Polhem. He now distinguished himself by various mechanical inventions and successful engineering projects, of which the most noteworthy was the construction of some rolling machines under the direction of Polhem, by means of which two galleys, five large boats, and a sloop were conveyed

14 miles overland, from Strömstadt to Idjerfol, to aid the king in his siege of Fredericshall. In 1719 his family was ennobled by Queen Ulrica Eleonora under the name of Swedenborg, and from thenceforward he became entitled to a seat in the house of nobles of the Swedish Diet, but he did not receive the title of baron, as has been supposed. In 1721 he made a short tour on the Continent for the purpose of visiting mines and smelting works, and on his return he was promoted to be full assessor of mines, the functions of which office he continued to discharge for the next twelve years. During this period of his life he published numerous small works and pamphlets on scientific and economical subjects, in all of which he displayed a rare power both of accumulating facts and applying principles. In 1729 he was admitted a member of the Royal Academy of Sciences at Upsala. In 1734 he published his "Opera Philosophica et Mineralia," in three stately folio volumes, finely illustrated, his patron, the Duke of Brunswick, at whose court he was a visitor, defraying the cost of the publication. The work consists of three distinct treatises, the first of which, the *Principia*, contains some new attempts at explaining the phenomena of the elemental world in a philosophical manner. The second and third portions treat upon iron and brass, discussing all the different methods then employed in Europe and America for preparing these metals. In the same year he published his "Prodromus Philosophiæ Ratiocinantis de Infinito" (An Introduction to the Philosophy of the Infinite), and these two works established his reputation for learning and philosophy throughout Europe. Christian Wolff and other foreign *literati* entered into correspondence with him, and the Academy of Sciences of St. Petersburg appointed him a corresponding member. In 1736 he commenced another series of travels, which lasted for three or four years, during which he applied himself chiefly to the study of anatomy and physiology, embodying the results in his "Œconomia Regni Animalis," a large work in two parts, 4to, published at Amsterdam in 1740–41, and his "Regnum Animale," of which parts i. and ii., 4to, were issued at the Hague in 1744, and part iii. in 1745 at London. This was the last of his scientific works, and concerning them as a whole it may be fairly said that they were received with high approval by those of his contemporaries who were best acquainted with the subjects upon which they dealt. They have long since ceased to be of practical value, but they yet retain some little interest as collections of facts and illustrations of the author's method of philosophy. By his adherents it has also been claimed that these writings contain some remarkable anticipations of subsequent scientific discoveries in astronomy, physics, chemistry, and anatomy. Perhaps the most important among these numerous productions is the "Economy of the Animal Kingdom," in which he attempts to deduce a knowledge of the soul from an anatomical and physiological knowledge of the body, and evolves many doctrines which he afterwards elaborated in his theological works.

In 1743, being then in his fifty-eighth year, the period of what he called his illumination began, and soon afterwards he openly assumed a new character, of which he gave, in a letter written in 1769, the following account:—"I have been called to a holy office by the Lord, who most graciously manifested himself in person to me, his servant, in the year 1743, and opened my sight into the spiritual world, endowing me with the gift of conversing with spirits and angels, which I enjoy to this day. From that time I began to print and publish various *arcana* that have been seen by me or revealed to me as respecting heaven and hell, the state of man after death, the true worship of God, the spiritual sense of the Word, with many other most important matters conducive to salvation and true wisdom." He now entirely abandoned the study of science, and spent the remainder of his life in writing and publishing books on spiritual subjects. He continued to discharge the duties of assessor to the Board of Mines till 1747, when he obtained permission to retire, retaining as a pension the salary of the office. His preliminary studies during this period were devoted to the Hebrew Bible, the first results of his meditation and illumination being the "Arcana Celestia," or a spiritual interpretation of Genesis and Exodus, interspersed with accounts of "wonderful things seen and heard in heaven and in hell," in eight 4to volumes, issued between 1749 and 1756. Then followed in quick succession a series of other works, including "Heaven and Hell," "On the Worlds in the Solar System," "On the New Jerusalem and its Heavenly Doctrines," "Angelic Wisdom concerning the Divine Providence," "The Apocalypse Revealed," "Conjugal Love," and "The True Christian Religion," all being written in Latin and published at his own expense. Besides these he left at death an immense mass of manuscripts, of which some portions have since been printed. and minute notes of his intercourse with the spiritual world in what he called his "Spiritual Diary," which has also been published. He spent much of the latter period of his life in Holland and England, for which countries he expressed great admiration on account of the freedom of speech and writing permitted there. He made no efforts to gain proselytes to his doctrines further than by printing and distributing his writings, and, except when questioned, he never in conversation referred to his intercourse with the spiritual world. In Sweden his works aroused some hostility, and a prosecution was instituted against him in the consistory of Gothenburg, which was transferred to the Diet, but he came out of the business unharmed, unaccused by the Diet, and protected by the king. He died from an attack of apoplexy in Great Bath Street, London, 29th March, 1772, being then in his eighty-fifth year. His body was buried in a vault of the Swedish church in Prince's Square, a little east of the tower. A eulogium was pronounced upon him in the Swedish house of nobles in October, 1772, which accords him high praise for learning and talent, and also for uprightness and fidelity in the discharge of his duties as a public functionary. Swedenborg was a man of simple habits, living chiefly upon bread, milk, and vegetables. He had great modesty and gentleness of bearing, singularly attractive manners when in society, and he was always kind to children. He was never married.

With respect to the theological teaching contained in the voluminous writings published during his lifetime and since his death, the general features are presented in his treatise entitled "The True Christian Religion." As to the place of his system in history, he taught that the world had been led through a series of dispensations, of which that of the church initiated by the advent of Christ came to an end by the Last Judgment, effected in the spirit world in 1757. Then commenced a new dispensation, signified by the New Jerusalem in the Revelation, of which he was chosen the precursor and his writings the doctrine. In his system of theology he maintains that God is one in essence and in person, and has been revealed to man as the Lord Jesus Christ. Differing both from Trinitarians and Unitarians, he maintained that in God was a trinity, not of persons, but of principles, and it is these principles which are spoken of in the Scriptures as Father, Son, and Holy Ghost. The Father is the divine love, the Son the divine wisdom, and the Holy Spirit the divine operation or energy acting upon the universe. Redemption, he taught, consisted not in vicarious suffering for men (which would be impossible, and if possible, useless), but by combats with the powers of evil on the part of the divinely assumed humanity, by which human freedom that had been impaired was restored, and the way of salvation opened up. Salvation was to be obtained by faith, repentance, and obedience

to the divine commands. The chief points of religion that he insists on in his writings are faith in the Lord, and the avoidance of evils as sins against him. He teaches with respect to eschatology, that heaven and hell exist not in some other region of space, but within the natural world, as the soul of man exists within his body, and that even in this life the spirit of man is unknown to himself either in heaven or hell, and is acted upon by influences from both, though he has power to choose between them. At death the body, which is the material envelope of the soul, is cast aside, never to be resumed, and the soul, rising into a conscious perception of the spiritual world, passes through a period of preparation, from which it is drawn by its own elective affinity to the place to which it belongs in heaven or hell, the condition thus attained giving the soul its bent for eternity. The Bible, or rather those portions of it that are inspired, contains an internal or spiritual sense, which may be discerned by the application of the law of symbolism resulting from the universal correspondence of natural with spiritual things. The inspired portions, or the Word, consists of the books of the Pentateuch, Joshua, Judges, Kings, Psalms, the Prophets, the Gospels, and the Apocalypse. The other books, though good and useful, do not possess the internal sense, and are not the Word.

As to his personal experiences, he believed himself to be in constant communion with the spirit world. For the instruction of men he was permitted to pass alive through all the experiences which accompany death. Under angelic guidance he visited the other worlds of the solar system, and entered repeatedly into some of the different states which make up heaven and hell. He was privileged to meet and converse with most of his friends and acquaintances who died during his lifetime, after they had reached the spirit world, and he met there many distinguished persons, whose remarks (in every case of a singularly Swedenborgian character) he narrates. It is a curious circumstance also that while he met the spirits of Louis XIV. and George II. in the heavenly kingdoms, he found King David and St. Paul the apostle in the infernal regions.

Most persons outside the circle of his followers regard his visions, illumination, spiritual experiences, &c., as the result of hallucination, and consider him to be, so far as these are concerned, the victim of mental disease. His followers, on the other hand, who were organized into a church in 1788 by Robert Hindmarsh, a London printer, accept his visions as well as his theology, or rather they regard them as its very foundation. They do not call themselves after his name, though they are generally known by it, but as the "New Jerusalem Church" they form one of the minor sects of Protestant Christendom, being found in the largest numbers in the United States, and also in England, France, Germany, Sweden, and Russia. The societies are not numerous, but they have never lacked men of learning, culture, and position. There is a Swedenborg Society in London, the members of which devote themselves to the printing and publishing of his writings, and from whom most of them may be obtained on very easy terms. The life of Swedenborg has been repeatedly written, the latest of his biographies, entitled "The Life and Mission of Emanuel Swedenborg," by Benjamin Worcester (Boston, 1884), giving a list of some three and thirty works of a biographical character.

SWEET'BRIAR (*Rosa rubiginosa*) is a species of ROSE (Rosa) belonging to the section Rubiginosæ. The sweetbriar or eglantine is common in Britain in bushy places on a dry gravelly soil. It is well known for the sweet balsamic odour of its foliage, due to the secretion of copious glands. The shoots are covered with numerous prickles of various size. The flowers are pink, and have a persistent calyx. The name is also sometimes given to *Rosa micrantha*, found in hedges and thickets in the south of England and Ireland, distinguished by its uniform prickles and deciduous sepals.

SWEET-FLAG. See ACORUS.

SWEET-PEA. See PEA.

SWEET-POTATO. See BATATAS.

SWEET-SOP is the fruit of *Anona squamosa*, a plant of the same genus as the CUSTARD APPLE. This species is a native of the Malay Islands, and is cultivated both in the East and West Indies for the sake of its fruit, which is greenish in colour, ovate, and covered with projecting scales. The rind is thick, and incloses a soft, sweet, luscious pulp with a musky aromatic taste and odour. The seeds are acrid, and are used powdered in India to destroy insects. The Sour Sop is the fruit of a nearly allied species, *Anona muricata*, a native of the West Indies. It is a large prickly fruit, and the pulp has an agreeable acid flavour.

SWEET-WILLIAM. See PINK.

SWEET-WOOD. See CASCARILLA.

SWE'GEN THE FORKBEARD, King of England and Denmark (whose name Swegen was in Danish *Svein*, and is sometimes modernized as *Sweyn*), was the son of Harold, the second king of Denmark, Harold Blaatand or Blue-tooth, as he was called. When the Emperor Otto II. ravaged Jutland in 975 in Swegen's boyhood, the young prince was made a Christian, with many of his countrymen, as one means of buying off the invader. But when Swegen grew up he felt indignant at his forced conversion, relapsed into the old Teutonic worship, and even headed a revolt of "Old-Danes" against his father, in which the king was beaten. Harold soon after died of his wounds, and Swegen succeeded him (985).

At this time the Danish yearly piracies on the coast of England had resulted in stations along all the eastern part (which was then, as now, called East Anglia) permanently held by the Danes. In 994 Swegen of Denmark and the famous Olaf Trygveson of Norway made a joint expedition of great force, mainly against London. The citizens beat them off by themselves, for little help was to be looked for at the hands of the then English king, Æthelred the Unready (*Unrede*, *i.e.* "of little counsel"). The Danes then ravaged Wessex till the unhappy king bought them off with heavy sums of money. The Chronicle says £16,000 in silver was paid. It is said that when in revolt against his father Swegen had sought asylum at Æthelred's hands in vain, which made him eager to join Olaf's expedition. Be that as it may, although Olaf troubled England no more after he and Æthelred had sworn friendship and the English bishop Ælfheah (St. Alphege) had confirmed him as a Christian, Swegen never again left England at peace. He stayed for several years, or rather his fleet and army did, plundering first here, then there, along the coasts. The Bristol Channel was harried in 997, Dorsetshire and the Wight in 998, Rochester and Kent in 999. In the year 1000 Swegen's ships met those of Olaf Trygveson in battle, for the Danish king's sister had been run away with by the great Norse hero, and other sources of quarrel, religious antagonism among the rest, had sprung up between the former friends; some treachery was used to cut off the King of Norway's galley, and Olaf was killed, overpowered by numbers. Swegen now became King of Norway, jointly with the King of Sweden (his ally against Olaf), and his power grew enormously. In 1001 he harried Exeter and Devonshire and gained enormous spoil, and the same happened in 1002, Æthelred once more buying off the invaders with huge bribes. Many of them settled in East Anglia, among them the husband of Gunhild, sister of Swegen. On Saint Brice's day the Danes, satiated with their bribe and their plunder, lying quiet, and many of their ships having gone home with the king, Æthelred caused all

who could be reached to be massacred, Gunhild falling among them, her husband and her son being murdered first before her eyes with circumstances of brutality. The princess invoked a bitter revenge on her murderers. This was not long in coming. Swegen now had hate as well as greed to nerve his attacks; and in 1003 he not only plundered Exeter but half ruined it, and also burned Wilton and Old Sarum. In 1004 he attacked the inland parts of East Anglia, first burning Norwich. Alderman Ulfcytel paid blackmail to buy a peace, and when Swegen treacherously broke faith, Ulfcytel fell on him with great bravery. It was a drawn battle, but it was sharp enough to cause Swegen to rest in Denmark during 1005. In 1006 Swegen ravaged Wessex and burned Reading and Wallingford, quite in the heart of England. Lavish bribes bought peace at last, and Swegen consented to retire. Æthelred set to work upon a fleet, but it proved useless when the Danes, under Jarl Thurcytel, came again in 1008. Every year Swegen sent his ships, and the miserable tale of harried counties and burned towns went on. The year 1009 is noteworthy for the help afforded to harassed England by the second Olaf of Norway (St. Olaf), who performed the feat of pulling down London Bridge, and thus cutting off the Danes in Southwark from their comrades in the castle on the Middlesex side (*i.e.* the castle afterwards rebuilt as the Tower of London by William the Conqueror). This bridge rested on wooden piles driven into the bed of the river, and was occupied by the Danes in large numbers. King Æthelred called a council of war, and after much discussion Olaf offered to attack the bridge with his ships. He protected his ships by a sort of temporary shield above the deck, and rowed close up to the piles supporting the bridge and made fast his anchor ropes to them. He then rowed with the stream and hauled at the ropes, with the result of loosening many of the piles. The bridge was loaded with large stones and fighting men in full armour. It gave way in places and many of the Danes fell into the water, while others fled to one side of the river or the other. As soon as the Danes in the castle saw that the river Thames was in the hands of the English and Norwegians, they surrendered it to King Æthelred. The bridge, in a strategical sense, was important, because, when destroyed, it admitted of the river being navigated by the Northmen's ships beyond London, from whence attacks could be made on the Danes. Then, well rewarded, the brave Olaf retired and set about his work of acquiring the crown of Norway. In 1011 Northampton was burned; and the Danes seem to have penetrated everywhere into the heart of the land, for Canterbury at the same time fell to them, and they spared only one in ten of the miserable inhabitants, plundering the city, burning the minster, and capturing Alfheah (St. Alphege), the archbishop, whom later on they murdered in a horrible way at Greenwich. The parish church, standing on the site of the martyrdom, is dedicated to his memory. Anything the Danes demanded was now paid to them to get them to hold their hand, and forty-five Danish ships were engaged as mercenaries by Æthelred, their leaders receiving land in East Anglia, with a view to buying their fidelity and converting them into a shield against their terrible countrymen. It was in vain. In 1013 Swegen Forkbeard himself came again, occupied the Danelagh or Danish East Anglia, and thence proceeded by organized incursions to conquer bit by bit of the country to the very heart of England, the genius of his son Cnut (afterwards Cnut the Great) showing itself in the solidity of the conquest. The Danes steadily swept across England, by Oxford, to Bath and Winchester. London, however, they could not take. But when all the rest of England gradually submitted and sent hostages, London submitted also. Æthelred fled to his forty-five Danish ships, the queen and the royal princes being sent to the queen's brother in Normandy. Swegen ruled England about a year and then died of some sort of stroke, possibly paralysis (1014). As he had been threatening the monks of St. Edmund's Bury just before, a legend grew up that St. Edmund (whom the Danes had martyred in 870) had avenged his monks by appearing as an armed man and striking down the blasphemer with a spear. Though he was but nineteen the Danes elected Cnut king in the stead of his father Swegen, but two years more passed before he really could be said to reign. As for Norway, Olaf II. (St. Olaf) was formally recognized as its king by Cnut in that same year of 1016.

SWELL ORGAN. See ORGAN.

SWEYN or **SWEIN.** See SWEGEN.

SWIETEN, GERARD VAN, honourably known for the distinguished service he rendered to several eminent musicians, was the son of Gerard Van Swieten (1700–72), the favourite physician of the Empress Maria Theresa. He was born in 1734, and soon showed a great fondness for music. Excellent as a judge and a critic Van Swieten was a fair performer and a diligent student of the great masters, but he never excelled as a composer, though he worked hard. Haydn said of him that his six symphonies were "as stiff as himself." But with his courtier-like stiffness Van Swieten had a thoroughly good heart. It is to a commission which he gave to Mozart to help him along that we owe the beautiful additional wind accompaniments to Handel's "Messiah," "Acis," "Ode to St. Cecilia," and "Alexander's Feast." He gave Haydn his travelling carriage when the composer went to England, and he translated the poems of the "Creation" and the "Seasons" into German that Haydn should fully understand them while composing his famous oratorios. He himself arranged Handel's "Athaliah" for performance. Nor were the younger musicians forgotten, as is evident by the dedication of Beethoven's first symphony to this wisely generous man. Van Swieten was employed on several state matters, his greatest diplomatic effort being the embassy to the court of Frederick the Great in 1771. His recognized musical rule at Vienna was, however, then, as now, his true distinction. He died in 1803.

SWIETE'NIA. See MAHOGANY.

SWIFT (Cypselidæ) is a family of birds belonging to the order VOLITORES. From the close resemblance both in outward form and habits between the swifts and the swallows (Hirundinidæ), these two families of birds were formerly considered to be very nearly related. Anatomical research, however, has proved the existence of deep-lying differences, and has rendered necessary their wide separation in the classification of birds. Thus the sternum or breast-bone of the swift is unnotched, while that of the swallow, which belongs to the order Passeres, has two deep notches in the posterior margin. In the swift again, the lower larynx is destitute of those special muscles by which the swallow and other singing birds are able to modulate their note so as to produce a song.

The typical Swifts (Cypselus) have the bill very short and weak, with the gape extending beyond the eyes, and the nostrils very large and oblong. The wings are extremely long, curved and pointed, reaching, when closed, far beyond the extremity of the forked tail, which consists of ten feathers. The legs are very short and weak, and covered in front with feathers; the four toes are all directed forwards, and have short, strong, curved claws.

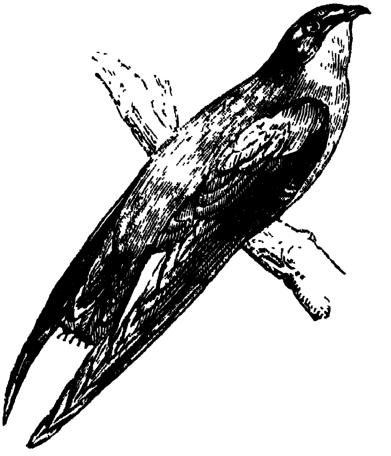
The Common Swift (*Cypselus apus*) arrives in Britain from Africa about the end of April or beginning of May, leaving again for its winter quarters early in August, so that its stay in this country hardly exceeds three months. It is a well-known summer visitor all over Europe; its range extends over the greater part of Western Asia, and in Africa it reaches as far south as the Cape of Good

Hope. Swifts arrive in this country generally in pairs, and are said to revisit their old breeding quarters year after year.

On its arrival the swift takes up its abode in holes and other sheltered places in church-steeples, towers, ruins, and under the eaves of houses. From these concealed nooks and corners it dashes forth in fine weather to wheel about in the air with inconceivable rapidity in pursuit of insects, accompanying its headlong flight with loud screaming notes; but when the day is unfavourable, and especially when there is a high wind, the swifts, notwithstanding their power of wing, usually keep close within their snug retreats. Their food consists entirely of insects, which they capture and devour on the wing. From the shortness and weakness of their legs they are very helpless on the ground. The nest is built in one of the ordinary holes inhabited by the birds. It is composed of fragments of straw, dry grass, moss, wool, and cotton, with a few feathers; and these materials are glued together by degrees, especially after the nest has been inhabited for several successive seasons, by means of a glutinous secretion produced by the largely-developed salivary glands with which the swifts in general are endowed. The eggs are dead-white and usually two in number, but vary from two to four, the latter number being rare. The young are hatched about the middle of June, but do not leave the nest for a month, during which time they are carefully tended by the parent birds. So imperative is the instinct to migrate that the young birds are sometimes deserted, if, when the time arrives for their departure, they are unable to join the parent birds in their long flight southwards. Only one set of eggs is produced, as a rule, in the season, but if they are destroyed by any accident the swift lays a second time.

The plumage of the swift is of a uniform blackish-brown colour, slightly glossed with green, but there is a small grayish-white patch under the chin. The total length is about 7½ inches, and the wings usually extend fully 16 inches.

The Alpine or White-bellied Swift (*Cypselus melba*) breeds in the mountainous districts of southern and central Europe, and extends as far east as India. In Britain it occurs only as an occasional straggler. It winters in



American Swift.

Africa, ranging as far as the Cape of Good Hope. It is larger than the common species, being about 8½ inches in length and about 20 inches in expanse of wing. The plumage is grayish-brown above, white beneath.

The American Swift (*Acanthyllis* or *Chætura pelagica*), the species to which the name chimney swallow is given in the United States, belongs to a genus distinguished by having the tail very short and slightly rounded at the extremity, the shafts of the feathers being stiffened and projecting as bare spines. It is 5½ inches long and 12½ in expanse of wing. The plumage is sooty-brown above, with a greenish tinge, grayish-white on the throat, and grayish-brown on the rest of the under surface. It arrives in the United States about the end of April or the beginning of May, and migrates southwards early in September. The nest is built usually in chimneys, but sometimes in hollow trees. An allied species, the Needle-tailed Swift (*Acanthyllis* or *Chætura caudacuta*), a native of Northern Asia and Australia, has been taken, but very rarely, in this country. The Tree Swifts (Dendrochelidon), which inhabit India and the Malay Archipelago, are beautiful birds, having the head usually adorned with an erectile crest or with tufts of feathers. The so-called Esculent Swallows (Collocalia), which breed in caves in India and the surrounding islands, construct the edible nests which are so highly prized by the Chinese. See NESTS, EDIBLE.

SWIFT, JONATHAN, a distinguished English prose writer, was born in Hoey's Court, Dublin, on the 30th of November, 1667. "Wretched Dublin, in miserable Ireland," he calls the city of his birth, and to the end of his life he was always anxious to disclaim the possession of Celtic blood, to insist that he was born of English parentage, and to resent the "offensive imputation" that because less than two years before his birth his parents had removed to that country, he could in any sense be considered an Irishman. His grandfather was a clergyman of an old Yorkshire family, who married a relative of the poet Dryden, and took an active part in the Civil War on behalf of the king. Jonathan, a younger son of this worthy priest, received in 1665 the appointment of steward of the King's Inns at Dublin, in which city he died, during the spring of 1667, leaving his young wife a widow with one child, and in the expectation of another. This second child, born under such sorrowful conditions, was Jonathan Swift. His early years were indeed romantic, for the English nurse who tended him became so attached to her charge, that, having to visit a dying relative at Whitehaven, she carried off the twelvemonths old babe in a bandbox, and the mother, fearful for his health, was content that the boy should remain in England for more than three years. At six years of age he was placed at the Kilkenny Grammar School, which, as Leslie Stephen remarks, has had the honour of educating the greatest satirist, the most brilliant writer of comedies (Congreve, a fellow-pupil of Swift), and the subtlest metaphysician in the English language (Bishop Berkeley). At fourteen Swift became a pensioner of Trinity College, Dublin, where, contrary to the statements of his earlier biographers, he appears to have done creditably, although like most men of genius he doubtless chafed under the narrow and pedantic system of scholastic study, preferring to wander at his own free will among the pleasant byways of literature. But events soon happened which forced him to break with Ireland. "Driven by stress of circumstances" he says, in reality by the anarchy which followed in the wake of the Revolution of 1688, he went to England, and after twelve months passed with his mother, who lived at Leicester, and whom he had not seen for fifteen years, he took up his residence with Sir William Temple, doubtless because his mother was a relative of Lady Temple. It is not quite certain what was the precise position in which at this time he stood to the great statesman of the Revolution. It was apparently a very humble one, for it is clear that this first period of residence at Moor Park, in Surrey, Sir William Temple's country seat, was very galling to a man of his proud temperament. The delightful tutorship of young Esther Johnson, an eight-year old protégé of Temple's, the companionship of King William III. in his walk round the gardens, the co-operation with

his master in scholastic controversy and diplomatic effort—all these were in the future. This first residence began in 1689 and ended in 1690, when Swift went back to Ireland with a letter from Temple recommending him for an appointment. This appointment he did not obtain, and in 1691 he returned to Moor Park, when his station in the household became a more dignified one; he was now the trusted friend and confidant of Temple, who, in his turn, was the trusted friend and confidant of the king. It was at the beginning of this second visit, when about twenty-four years of age, that he went up to Oxford and obtained a degree from that university. At this time also he commenced to write poetry, and drew down upon himself the emphatic criticism of Dryden, "Cousin Swift, you will never be a poet." Swift never forgave this very frank statement of fact, and was soon to have his revenge in unequalled prose. In his great satire "The Battle of the Books," Dryden is very hardly dealt with. When Temple was laid up with gout his secretary had the distinguished honour of receiving King William, who, while walking about the grounds, condescended to initiate him into the mysteries of Dutch gardening, and later, during a discussion on the Triennial Bill, Temple being too ill to attend the court in person, Swift was despatched to London to talk over the political situation with the king. But a slight quarrel with his patron caused him once again to leave him, and he went back to Ireland, took holy orders, and obtained in January, 1695, by family influence, the living of Kilroot, near Belfast, with an income of £100 a year. Soon wearying of the monotony of clerical life he returned to Moor Park in the spring of 1696, and now the real romance of his life commenced. Esther Johnson, a mere child at Swift's earlier visit, had reached the age of fifteen. It might have been thought that her heart was safe from the passionless student, the remorseless satirist of thirty. But though she was graceful and beautiful, though she was one of the *belles* of fashionable society (Lord Macaulay is in error in describing her as merely a lady's-maid), she, like her unfortunate rival of later years, Hester Vanhomrigh, was entirely taken captive by the all-dominating intellect of Swift. At present Swift only superintended her reading, but he found time for the composition, or at least the completion, of two famous works, the "Tale of a Tub" and the "Battle of the Books." The death of Temple in 1699, who bequeathed to him the labour of editing his writings, delayed the publication of these works until 1704. "The Battle of the Books" was Swift's contribution to the great Bentley controversy. The antiquity of the "Epistles of Phalaris" had been assumed by Sir William Temple in an essay on the superiority of ancient over modern literature. Bentley, with his vast learning, had no difficulty in accumulating proof on proof to show that these epistles were spurious. Swift came to the rescue of Temple on a side issue. He misconceived the merits of the case and was technically in the wrong, but his satire is a vigorous protest against that pedantry which has thoughts for the letter and not for the spirit of good literature. Through the fable of the "Spider and the Bee" he illustrates the "sweetness and light" of the ancients, and has supplied Matthew Arnold with an apt phrase for his keenly judicious literary criticism.

The "Tale of a Tub," probably written a year earlier, in 1696, is a satire of remarkable power. "Great God, what a genius I had when I wrote that book" Swift exclaimed long afterwards. About one-third of the work is taken up with ecclesiastical disputes, the disputants being indicated by three brothers, who variously interpret the terms of their father's will—Peter representing the Roman Catholics, Martin the English Church, and Jack the Dissenters; but it is the remainder of the work, its dedications and digressions, its satire on contemporary life and contemporary authorship, that justifies its claim to be considered one of the greatest masterpieces of English prose. After Temple's death (1699), Swift became chaplain to Lord Berkeley, the new viceroy of Ireland. When in Ireland, Lady Berkeley evinced a singular partiality for Boyle's "Meditations," which she would ask Swift to read aloud to her of an evening. Weary of such pious platitudes, he ventured at last to substitute a meditation of his *own* "On a Broomstick," which Lady Berkeley accepted in all good faith. The parody was published in 1710. Berkeley gave him the living of Laracour, a village near Trim, some twenty miles from Dublin, where his congregation rarely numbered more than fifteen persons, and on one occasion consisted only of himself and his clerk, when he commenced the service with "Dearly beloved Roger, the Scripture moveth you and me," and so on. In 1701 he published his first political tract, "A Discourse of the Dissensions between the Nobles and Commons in Athens and Rome," its object being to draw lessons for his own day from the violent outbursts by which Athens and Rome made shipwreck of their liberties. This pamphlet introduced him at once to the notice of the leading Whig statesmen, Somers, Halifax, and Godolphin. In the same year, at his recommendation, and partly out of esteem for him, partly for economy's sake, Esther Johnson, henceforth to be known as Stella, came to live in Ireland, settling with her friend Mrs. Dingley at Trim, two miles from Laracour. Swift was often in London busying himself with his political friends, and it was from hence that the incomparable letters comprised in the "Journal to Stella" were written. These letters describe with graphic insight the circles amid which Swift moved, they are written with an entire freedom from conventionality and yet not in the language of a lover, while appearances are saved by the inclusion of the elder lady in the amenities of "our own little language," as he describes the peculiar manner of his letters. "Good night, my-own-little-dear-saucy-insolent rogues" is a phrase culled at random from this delightful and interesting correspondence. In 1708 appeared his "Letter upon the Sacramental Test," which denounced relaxation of the repressive laws against nonconformity. This was followed in the same year by his "Argument against the Abolition of Christianity," and "Predictions for the year 1808, by Isaac Bickerstaff." To the next year (1709) belong his "Project for the Advancement of Religion, and the Reformation of Manners," and his twenty papers contributed to Steele's *Tatler*. In 1710 a Tory government came into power, and Swift, who had hitherto been associated with the Whigs, now came to identify himself with their rivals. It is not necessary to account for this change on the assumption that Swift possessed the clerical peculiarities of the Vicar of Bray. Nor is it necessary to assume the most absolute disinterestedness on his part. It is certain that the Whig party had rewarded his services with abundant promises, and nothing more. He had a right to expect that his genius would bring him something more than a beggarly Irish pastorate, at a time when the patronage in the hands of ministers was enormous. But the most potent motive for Swift's change of view was doubtless his recognition that the privileges of his much-beloved Anglican Church were safer with the Tories than with the Whigs. A stanch Protestant, he had early been a Whig, because that was the party of the Protestant succession. Passionately devoted to his church, he was now to become a Tory, because that was the party of Episcopal privilege. The *Examiner*, which he conducted for some time, contained his first efforts on behalf of his new allies, and he soon became a confidential and trusted friend of the Harley and St. John Cabinet. The attempt which they made to reward him with the Bishopric of Hereford was frustrated by Queen Anne's opposition, it being represented to Her Majesty that the author of "The Tale of a Tub" could not be a Christian. In 1712 Swift wrote, in

the form of a letter to Harley, the only one of his multitudinous publications to which he attached his name, "A Proposal for correcting, improving, and ascertaining the English Language," in other words a proposal for an academy. In the following year he was made Dean of St. Patrick. In the meantime he had founded during his residence in London the October Club, which was at first intended for Tory politicians and wits, but the politicians quarrelling, the club soon became exclusively literary, and took the name of the Scriblerus Club.

The death of Queen Anne, in 1714, ruined the Tory party, and Swift left England for his Irish deanery. To Ireland he was soon followed by Hester Vanhomrigh, the Vanessa of his correspondence, whom he had met in London, and who, it is clear, had completely lost her heart to him. The mild flirtation of London life being followed by coldness and restraint in Ireland, together with, as it is asserted, the announcement that Swift was actually married to another, is said to have broken Miss Vanhomrigh's heart. She died in 1723. That Swift was really married to Stella in 1716, as is sometimes assumed, is in the highest degree improbable. The marriage, if it took place at all, was a mere ceremony undergone to still the restless jealousy of the woman he loved. Abundant reasons are assignable for Swift's unwillingness to marry; his dread of poverty, his breaking health, his cold temperament, and perhaps more than anything else the dread of ultimate insanity which hung over him nearly all his life, and which may well make us judge his weaknesses with a sympathetic charity.

In 1720 Swift published his "Proposal for the Universal Use of Irish Manufactures," and in 1724 his "Drapier Letters." These originated in the attempt of the government to force a debased copper currency, known as "Wood's Halfpence" (from the name of the speculator who had obtained the monopoly), upon the people of Ireland. The Letters caused immense excitement, and the government were at length compelled to recall the halfpence. In 1727 the whole reading world was dazzled and delighted by "The Travels into Several Remote Nations of the World, by Lemuel Gulliver," which, although published anonymously, was immediately recognized as Swift's. It was, it may be added, the first classical work of fiction to appear periodically in a newspaper. It came out, not only in the ordinary course, but also in a journal of the day called *Parker's Penny Post.* It was almost immediately translated into French by the Abbé Desfontaines, at the suggestion of Voltaire. Few books of any kind have so delighted the youth and manhood of that and of every succeeding generation. To add to the reality of his great work, Swift added maps of the country visited by his hero, as well as a portrait of him; but without such maps and portrait the work is intensely real. If Swift had done nothing more than write the most delightful of children's story books, his place in English literature would indeed be high; but "Gulliver's Travels" is much more. That very unenthusiastic old philosopher, William Godwin, spoke of the "inestimable wisdom" of the work, and declared that it "showed a more profound insight into the true principles of political justice than any preceding or contemporary author;" and this estimate has been endorsed by the wisest men of Swift's age and of our own. In 1728 Esther Johnson died at the age of forty-six. All the pathos and all the tragedy of her lifelong friendship and devotion are summed up for us in the words which Swift had written on an envelope containing a tress of hair, which was found after his death, "Only a woman's hair!"

During the next ten years pamphlets, tracts, satires, and poems came from him in astonishing numbers. By far the most powerful of them is "A Modest Proposal for Preventing the Children of the Poor People in Ireland from being a Burden to their Parents or Country, and making them Beneficial to the Country," which Leslie Stephen describes as "one of the most terrific satires ever written." The "Modest Proposal" in question is that the children should be sent with the oxen and sheep to the butcher. Swift saw only too clearly that the English methods of governing Ireland could mean nothing but starvation for large masses of the population, and he selected this gruesome method of emphasizing the horrors of the situation and the need for definite remedies. Yet his satire can scarcely be termed effective when we remember that even a century later a population of 8,000,000 was reduced by nearly one-half in the terrible Irish famine of 1847. In 1741 the mental insanity, the fear of which had been hanging over him like a dark cloud since his early college days, took possession of him. On 19th October, 1745, in his seventy-eighth year, he died, and was buried in the south aisle of his cathedral, in the same grave with Stella. The inscription upon his monument, in Latin, written by himself, reads thus:—"Here is deposited the body of Jonathan Swift, S.T.P., Dean of the Cathedral Church, where Fierce Indignation can no longer lacerate the heart. Go, you who pass by, and imitate, if you can, a strenuous assertion of Freedom."

Swift has been the object of severe depreciation by fellow-Tories like Johnson and De Quincey, as well as by opponents like Jeffrey and Macaulay. Addison, on the other hand, who knew him well, described him as "the most agreeable companion, the truest friend, and the greatest genius of his age;" and our own epoch has abundantly recognized not merely his extraordinary powers as a prose writer, but his many excellencies as a man. To dwell upon his bitterly controversial spirit and his other weaknesses, is to dwell upon one phase of his character only. He was, according to his light, generous and kind. His exertions while an influential member of the Tory party, on behalf of his poorer literary brethren, were untiring. The true relationship in which he stood to Stella and Vanessa will perhaps never be known. Swift may have looked upon his years as a sufficient guarantee for a fascinating friendship; and it may have been that Swift made his views on the marriage state quite clear. "Matrimony," he writes, "has many children—repentance, discord, poverty, jealousy, sickness, spleen, loathing," and he preferred a freer but more lasting emotional friendship. To the outer world Swift, like Carlyle a century later, was a writer of matchless style, whose burning words against "cant" and "shams" have been of incalculable influence for good to mankind.

Swift's Life, by Sir Walter Scott, forms the second volume of Scott's prose works, and the first volume of the nineteen-volumed edition of Swift. John Forster's unfinished biography (1876) was succeeded by Leslie Stephen's interesting monograph in Macmillan's Men of Letters Series (1882). Henry Craik's "Life" (1882) may be described as the standard biography. See also Howard Williams' "English Letters and Letter Writers" (1886). The complete works of Swift are not easily obtainable, but the two beautiful little volumes in Kegan Paul's Parchment Library, "Selections" and "Letters," edited by Stanley Lane-Poole, give a very adequate idea of the writer. His poems, which have an interest apart from their intrinsic merit, may be obtained in the Aldine edition of the poets. For Swift's quarrel with Steele, see Austin Dobson's charming life of the latter writer.

SWILLY, LOUGH, an arm of the sea on the north coast of Ireland, in the county of Donegal, extending inland nearly 25 miles, with an average breadth of 2 miles. It forms a capacious and well-sheltered roadstead, but is not much frequented.

SWIMMING, the art of keeping the body afloat in water and propelling it by means of the hands and feet.

Most animals swim naturally, but the art has to be acquired by man, though as the specific gravity of the human body is very little greater than water, it can be floated with but little difficulty. The floating is greatly assisted by propulsion, just as a thin flat stone may be kept from sinking by projecting it with force against the surface of the water. In learning to swim, the first essential is confidence, and no progress can be made until the learner feels assured that the water will support him. When the lessons are taken in a river, lake, or off the sea-shore, Dr. Franklin's suggestion may be used to advantage:—"Let the pupil wade out breast deep, then face about and toss an egg or white pebble into the water between himself and the shore, and then plunge after it. In struggling to reach it he will find himself buoyed up by the water, and will learn that it is as easy to swim as to sink." Some teachers inspire confidence while imparting instruction, by supporting the pupil on the flat of the hand; but where lessons can be taken in a swimming bath, the method adopted in the swimming-schools of Prussia is the best yet devised. In this the teacher stands on a platform raised a little above the edge of the water behind a strong oak rail, running horizontally to the extent of 20 or 30 feet, and about 4 feet high from the level of the platform. He holds a pole of about 9 feet in length, to the top of which a rope is attached. This rope descends towards the water, and is inserted in the ring of a belt fixed under the arms of the learner, who lies along the water. The wooden rail thus becomes the fulcrum, and the staff a lever. It is managed with ease by one hand of the teacher, as the staff rests upon the rail, and also has the other end upon the ground. The learner is supported by the rope which rises from the ring between his shoulders. He is there carefully instructed in the various movements, singly at first, and is made to repeat them until they are quite familiar to him. When the learner begins to be able to support himself the teacher raises the lower part of his staff (resting against the rail), which thus lowers the top, and therefore slackens the rope, but instantly brings the staff into a more perpendicular position if he sees the pupil sinking. When he can swim ten strokes in succession the staff is abandoned, and the master only holds the rope; when he can swim forty or fifty strokes the rope is taken away, but the teacher always keeps near enough to reach him with a long pole. The pupil is not considered safe until he is able to swim for half an hour without resting or receiving assistance.

Similar lessons might be given from the level bank of a river, provided that the water was sufficiently deep. The use of corks, bladders, life belts, &c., is now nearly obsolete in teaching swimming, as they tend to retard the learner's confidence in the natural buoyancy of the water, and they are moreover a source of danger from their liability to slip from the shoulders and entangle themselves round the legs. Most persons learn to swim on the breast, this method being the commonest, and in some respects the easiest, and the motions necessary may be briefly described as follows:—The body should be kept in a nearly horizontal position in the water, with the back hollow, slanting and steady, and propulsion should be attained by the arms and legs being simultaneously flexed and drawn slowly to the body, and then simultaneously and rapidly extended. The two hands should be kept open, the fingers together, the thumb placed by the side of the first finger, and the knuckles slightly raised, and the swimmer should reach forward with his hands as far as he can, for the further forward he reaches the faster will he swim. At the same moment both legs are drawn well up beneath the body, and then while each hand is brought round with a sweep, one to the right and the other to the left, the legs are thrown back and the feet vigorously pushed against the water. It is essential to a good stroke that the legs should be widely extended, while the hands should sweep as far beyond a horizontal extension as can be effected without straining. The motion of the arms and hands having been made the action is instantly relaxed, and they are drawn up for a repetition of the stroke, the legs being at the same time drawn in under the body. In drawing up the legs the toes should be pointed backward to avoid the resistance of the water against the insteps. Breast swimming is the only method possible for long distances, but for swift motion in the water the side stroke is generally adopted. In the latter the swimmer throws himself upon the side and advances the arm underneath him in a curve, making it act as a cutwater, while the right arm directed downward and backward and the legs make a powerful stroke. The strong backward stroke of the three limbs gives a powerful forward impulse, and as the body is on the side, as on a keel, the resistance is much reduced. The overhand stroke, made by reaching forward with the arms out of the water and advancing the right and left sides of the body alternately, is even faster than the side stroke, but it is very exhausting, and can only be used for short spurts. Swimming on the back is easier, so far as the support of the water is concerned, than swimming on the breast, the body being more nearly horizontal, and the head being partly in the water. On the back it is not difficult to swim by using the legs only, the arms being folded on the breast, or the legs may be extended and the arms used for propulsion. To float on the back the swimmer suffers the back of the head to be submerged, the face only being above water, the arms are extended, and the legs partially flexed and spread so as to offer the greatest possible floating surface. In treading water the swimmer's body is in an upright position, with the head well out, and a rapid motion of the feet, as in ascending steps, is the sustaining and propelling power. The hands may be either kept still or used to assist in propulsion. Swimming on the back and treading water are useful reliefs in long swims. In diving, the hands are brought together in front to cleave the water and protect the head, and the legs are kept straight, the heels touching each other. If the diver desires to come almost instantly to the surface again he has only to direct his hands above his head. As salt water is more buoyant than fresh, it is easier to swim in it.

With regard to swimming as an exercise, care should be taken to avoid water which contains cold springs or beds of weeds, or which is subject to strong currents or tides. It is always dangerous to enter the water in a state of perspiration, or when the body is cold and chilled, and bathing should not be indulged in immediately after a full meal. If subject to the cramp a swimmer should not venture out of the reach of assistance. In attempting to save a drowning person the swimmer should approach him from behind, and wait until he can get a grasp of the upper part of the arm, so as to keep him from closing, for should the struggling person seize his would-be helper both may be lost. For swimming matches, the training is like that for any other exercise, which, according to Captain Webb, "simply means a healthy life." In the warm southern seas the natives, who spend much of their time in the water, are able to swim for many hours without exhaustion, but in northern climates the low temperature of the water prevents, as a rule, any very prolonged immersion. During recent years, however, some unusually long swims have been accomplished, the most noteworthy of these feats being that of Captain Webb, who swam from Dover to Calais (24–25th August, 1875), the tide making his course a zig-zag of about 40 miles, his time being $21\frac{3}{4}$ hours, and the feat of Mr. Cavill, who two years later swam from Cape Grisnez to the South Foreland in twelve hours. In both cases the swimmers were attended by boats and supplied with refreshments, which they took while treading.

SWIN'DON, a town of England, in the county of Wilts, about 41 miles north from Salisbury and 77 miles from London on the Great Western Railway, is situated on a hill commanding an extensive prospect, and consists of five principal streets irregularly laid out, but well built, airy, and neatly kept. It contains a town-hall, assembly rooms, and spacious corn exchange, several schools, a literary institution, and a well-attended weekly corn market. There are some large cheese factories and sewing works. The parish church is a Gothic building. There are several places of worship for dissenters, and a church for the railway employés erected near the station, where the Great Western Company have their principal workshops, employing over 5000 hands. At New Swindon, as this railway colony is called, are a church, a Roman Catholic church, several dissenting chapels, large and convenient schools, a market-house, a theatre, and a literary institute, and some excellent charities in active operation. The population of Old Swindon in 1881 was 4696, and of New Swindon, 17,678.

SWINE. See HOG; PIG.

SWIN'EMUNDE a fortified town of Prussia, in the province of Pomerania, 43 miles by water from Stettin, whose out-port it forms, on the Baltic, on the east coast of the island of Usedom, at the entrance of the Swine, one of the mouths of the Oder, with dockyards, an excellent harbour, and considerable trade. It is much frequented as a bathing-place. It imports coal largely from England, but has no export trade. The population is 12,000.

SWING, CAPTAIN, an appellation notorious in 1830 in the agricultural districts of England, from its assumption by the concoctors of threatening letters to landlords, millowners, farmers, and other employers. The introduction of machinery, the pressure of the corn laws, the low rate of wages, and various causes had combined to produce great distress in the lower orders, who conceived that they could only improve their condition by insisting on the abolition of machines and the substitution of manual labour. Accordingly, they addressed missives to their employers, requiring them to desist from the use of machinery, or, in default, menacing them with loss of property. These missives purported to come from "Captain Swing," and if disobeyed were promptly followed by incendiary fires. The arrest and punishment of the principal offenders, however, gradually accomplished a return to the normal state of tranquillity.

SWITCHES are short pieces of railway bars movable upon joints at one end, and applied at the points of junction between the two lines of rails, for the purpose of guiding the wheels of the carriages from one to the other. Switches are capable of considerable variety of form and application. They may be either single or double, self-acting, or worked by hand, &c. Switches are also much used in electrical apparatus and especially in telephone work.

SWITH'IN, or **SWITHUN, ST.,** seventeenth bishop of Winchester, was born in the early part of the ninth century. He was chaplain to King Egbert, and tutor to his son Ethelwulf, and in the reign of the latter became chancellor. He was also intrusted with the education of Alfred, whom he accompanied to Rome. His services were rewarded in 852 by his elevation to the see of Winchester. He is supposed to have procured the first Act of the Witenagemot for enforcing the universal payment of tithes. He died 2nd July, 862. His last request was that he should be buried in the churchyard of Winchester; but within a century afterwards, his name having been admitted into the calendar as that of a canonized saint, it was resolved to transfer his remains to the cathedral, and to place them in a magnificent shrine which had been prepared for the purpose by King Egbert. The translation, which was to have taken place on the 15th July, was delayed for forty days in consequence of the rainy weather which occurred, and hence arose the well-known tradition that if it rains on St. Swithin's-day, it will rain for forty days successively; or if it be fair, it will continue fair for forty days. As a general rule, a period of wet weather setting in about the summer solstice may be expected to last for a considerable time, and this circumstance has given rise to a similar belief in France with respect to the fête days of St. Médard (8th June), and St. Gervais and St. Prolais (15th June); while in Holland it is connected with St. Godeliéve. The French proverb is in rhyme:—

> "S'il pleut le jour de St. Médard,
> Il pleut quarante jours plus tard;
> S'il pleut le jour de St. Gervais,
> Il pleut quarante jours après."

The festival of St. Swithin in the Roman Martyrology is 2nd July, the day of his death, but in England it was celebrated on 15th July, the day appointed for the translation of his relics to the cathedral of Winchester.

SWIT'ZERLAND (Ger. *Schweitz*, Fr. *La Suisse*), a country of Europe bounded N. by Bavaria, Würtemberg, and Baden, from which it is separated by the Lake of Constance and by the Rhine, except in three or four places, where the canton of Schaffhausen and a part of that of Zürich extend to the right bank of the river, E. by the Tyrol, S. by Italy, and W. by France. It measures over 200 miles near 46° 30′ N. lat., from W. to E., with a width of about 130 miles at 9° E. lon. The area is 15,992 square miles, and the population, according to the census of 1880, was 2,846,102.

Surface.—The surface of Switzerland is very mountainous, but presents greater variety than most countries of Europe. The ranges of the ALPS and their numerous offsets extend over the southern and south-eastern districts, and along the western boundary run the ridges of the JURA Mountains. The country between these two systems assumes towards the south the form of a plain, interspersed with isolated heights; and towards the north it is traversed by ridges or groups of hills of moderate elevation.

The Alpine region includes more than half of the area of the whole country, and many of its peaks rise from 9000 to 15,000 feet above the level of the sea. It exhibits every variety of mountain and valley, naked precipice and wooded slope, crystal stream and roaring torrent, with a vast extent of perpetual snow on the loftier elevations; and of glacial ice-fields creeping down from them into deep glens, in strange contrast with their fresh green sward, fruitful orchards, and pleasant cottages. The main chains are crossed by means of gorges, which cleave the mountains to the depth of several thousand feet, though in many instances they are mere rents or the beds of torrents. Several of these routes are good carriage roads, made with immense labour by blasting the rocks, tunnelling through them, and bridging the chasms; but the greater number, from forty to fifty altogether, are either simple footways or bridle paths, often winding through terrific scenery, and seldom travelled except in summer, being blocked up with snow through the winter months. The principal passes, from east to west, are:—

	Height in feet.
Great St. Bernard, from Martigny to Aosta, in Piedmont,	8,185
Cervin, or Matterhorn, from Zermatt to Chatillon,	11,000
Simplon, from Brieg to Domo d'Ossola, in Lombardy,	6,592
St. Gothard, from Altorf to Bellinzona,	7,087
Splügen, from the Grisons to Chiavenna,	6,939
Gemmi, connecting the cantons of Bern and Valais,	7,596
Grimsel, through the Bernese Alps,	7,126

The Jura Mountains present a totally different aspect to that of the Alps. They nowhere reach the elevation of perpetual snow, and are clothed from their base to their summit with magnificent pine woods. All the principal lakes and important towns are situated in the plain of Switzerland, which extends from the north-east to the south-west of the country, between the lakes of Geneva and Constance. As before stated, this part of the country, though called a plain, is far from being absolutely level, but is interspersed with slight elevations, which are, however, quite insignificant when compared with the heights of the Alps and Jura.

Geology.—Primitive rocks, granite, gneiss, and slates compose the upper parts of the Alps. These are flanked by secondary formations, the equivalents of the British oolitic limestones, which occur at great heights, and serve to mark the comparatively recent date of the alpine upheaval. Similar limestones form the entire mass of the Jura range and indicate its age. The intervening plateau consists generally of tertiary strata, comprising alternations of soft limestones and sandstones, with clays and marls. With the exception of marble, building stone, and iron, the mineral produce of the country is of much less importance than would naturally be supposed from its mountainous structure; but its resources in this respect are by no means fully known. Salt springs abound, but they are generally neglected, except those of Bex in the canton of Vaud. There are nearly 300 mineral springs altogether. The one most resorted to is that of Leuk, in the canton of Valais, which is 4500 feet above the sea, and has a temperature of 124°. Coal has been found in small quantities in Freyburg, Vaud, Basel, and Thurgau, but it is mostly of a very inferior quality.

Rivers.—The high Alps form vast reservoirs, whence issue thousands of fertilizing torrents, but owing to the mountainous nature and inland position of the country, none of the rivers acquire so much development within its limits as to become of great navigable importance. The Rhone and Rhine both have their sources in its glaciers, and the Danube and the Po are indebted to it for important tributaries. The Rhine, formed in the canton of Grisons by the junction of the Vorder and Hinter Rhein, flows north into the Lake of Constance, and then, on emerging from the lake, winds westward to Schauffhausen, where it forms the celebrated falls of that name. Below these falls its navigation properly begins, and is continued west along the frontier to Basel, where a sudden turn north carries it into Germany. Its principal affluents in Switzerland are the Thur, Töss, Birs, and Aar, which all join it on the left. By far the most important is the AAR, which not only traverses a large part of the country circuitously from the south of Bern to the north frontier, but is augmented by a great number of important affluents, of which the largest are the Limmat, Reuss, and Emmen on the right, and the Saane and Thiele on the left. The Rhone, rising in the glacier of St. Gothard, on the north-east confines of the canton of Valais, receives all the drainage of that canton, flowing through it centrally, first W.S.W. and then N.N.W., till it falls into the Lake of Geneva. Immediately after issuing from the lake at the town of Geneva, it receives the Arve, and about 10 miles below quits the Swiss frontier. A visit to the confluence of these two strongly contrasted rivers—the Rhone, blue, clear, and stately; the Arve, muddy, brawling and torrent-like—is one of the pleasantest excursions that can be made from Geneva. The waters which the Po receives from Switzerland are carried to it by the Ticino, which drains the canton of that name; those which augment the Danube are poured into it by the Inn, which rises and has a considerable part of its upper course in the east of the canton of Grisons. The whole drainage of Switzerland is thus divided among the four basins of the North Sea, the Mediterranean, the Adriatic, and the Black Sea. The proportions received by each are in the order just stated, but by far the largest share belongs to the first.

Lakes.—No country in Europe, except Scandinavia, has, in proportion to its size, so many lakes as Switzerland. Those of the Alpine regions occupy the lower parts of the valleys. They vary in depth from 500 to 1900 feet, and are situated at an elevation of from 1200 to 1800 feet above the sea. The most important are Lake Leman or the Lake of Geneva, Thun, Waldstatten or Luzern, Zug, Wallenstadt, Zürich, Constance or the Boden See; and, on the south of the Alps, part of Lugano and Maggiore. Most of these are traversed by steamboats. The table-land contains Lakes Morat, Sempach, Baldeck, Hallwyl, Greiffensee, and Pfeffikon. In the Jura are the Lakes of Neuchatel and Bienne, the first of which is traversed by steamboats.

Climate.—The climate of Switzerland, owing to its elevation and other causes, is much more severe than might be expected from its position, nearly in middistance between the equator and the North Pole. It presents the greatest extremes and the most violent contrasts. The cold of the polar zone coexists with a moderate temperature at a subjacent level, greater mildness below, and oppressive heat in the deep and close valleys, owing to the confinement of the air and excessive radiation from the high rocky walls on either side. There are some human habitations at 6000 and even 7000 feet high, and many villages are 4000 feet above the sea; but the most populous part of the country is situated at an elevation of between 1200 and 2100 feet—the average temperature there throughout the year being about 3° less than that of London, although in the summer it is 3° hotter. The same causes which diversify the climate tend also to make it extremely variable, even in the same localities; and hence days of almost insupportable heat are not unfrequently preceded by cold mornings or equally cold evenings. These sudden changes are very trying to weak constitutions, and sometimes make epidemic diseases generally prevalent; but with the exception of a few swampy spots from which a deleterious malaria is diffused, the air is clear and bracing and eminently favourable to health. South-west winds are frequent and usually bring rain; the air from the north-east, which blows on the table-land in spring, is cold and dry. The warm south wind greatly favours the climate of the canton of Tessin; but, under the name of *Fohn*—the sirocco of the Alps—it blows with extreme violence, and sometimes causes great damage on the lakes. The quantity of rain that falls annually on the southern declivity of the Alps amounts to 57·83 inches; while on the western side it is only 47·17, and on the northern not more than 36·13. The large lakes are seldom frozen. On the table-land and the lower mountains snow falls in greater abundance than in other countries of the same latitude in Europe, and on St. Gothard at least once a month in summer. The climate in the alpine regions is believed by some to have become colder in recent times, as the line of perpetual snow has certainly descended lower, the glaciers have increased in number, and many tracts are now bare which were formerly covered with forests and pasture grounds.

Products, Agriculture, and Animals.—Few countries in Europe, even of a larger extent, can boast of a more varied vegetation than Switzerland. It has been divided into seven regions. The characteristic product of the first is the vine, which grows up to 1700 feet, and in some districts of Zürich and the Lake of Thun to 1800 feet above the sea level. In this region wheat ripens to perfection, and rich supplies of fruit are obtained. The chestnut and mulberry trees are also extensively cultivated. The next division in ascent is the hilly or lower mountain district, which rises to the height of 2800 feet, and is characterized by the luxuriance of its walnut trees and oaks. Though

not well adapted for wheat, it produces good crops of spelt; rye and barley are also successfully cultivated, and it has excellent meadows, from which two crops of hay are generally obtained annually. The third or upper mountain region has its limit at 4100 feet. Its principal product is forest timber, consisting of all the varieties of hard wood, but more especially beech. The walnut grows in it, though not vigorously, up to 3500 feet; and fair crops of barley and oats are still obtained. The pastures, too, are excellent. Above this, and up to the height of 5500 feet, lies the fourth or subalpine region, distinguished by its pine and maple forests. Here winter lasts from eight to nine months; no regular crops are grown, but occasionally some kinds of kitchen vegetables and a few potatoes of small size may be obtained. Many of the heights are covered with a rich grassy sward. The next two regions are sometimes included under the common name of alpine, though they are evidently distinct in character; the one, lower alpine, terminating at 6500 feet, and the other, upper alpine, ascending to the limit of perpetual snow. The former is the proper region of alpine pastures; the latter, as it ascends, becomes more and more stunted in its vegetation, and the variation of the season is lost, spring and autumn being altogether excluded, and a winter of rigorous severity following close upon a short summer of only five or six weeks. The seventh and last region is that of perpetual snow. Although agriculturists have thus defined the different heights according to the especial characteristics of each zone, they are often found to encroach on one another.

Many parts even of the lower regions of Switzerland are of a stony and sterile nature, but on every side the effects of persevering industry are apparent, and scarcely any spot that can be turned to good account is left unoccupied. Up to the present time, however, the quantity of grain produced is not equivalent to what the land might afford, if there were sufficient pains taken to enrich it. The pasture grounds and vineyards require so large an amount of manure, that there is not sufficient left for the agricultural purposes of those lands which are tilled, and the result is a poor and scanty harvest. In some cantons no bread grain whatever is grown, but a few small fields of barley and a little Indian corn, sown at the bottom of the valleys, serve as an apology for a harvest. The deficiency is supplemented partly by importation, and partly by the cultivation of potatoes, the growth of which has very much extended during the last century in all parts of the country. This vegetable is found to bear the mountain climate very well, and being of rapid growth, is admirably suited to the short summers of an alpine country. The peasants use it for food almost as freely as the Irish, and cook it in various ways. In the more mountainous districts dairy produce forms the chief article of subsistence. In fact the most characteristic feature in the rural economy of Switzerland is decidedly that of its pasture lands. In no part of the world is so large a proportion of the surface devoted to grazing purposes; for of every 100 square miles of land, 20 are pasture, 17 forest, 11 arable, 20 meadow, 1 vineyard, and 30 uncultivated, or occupied by water, rocks, and glaciers. The pastures and meadows thus form the most staple source of profit to the country, and are cultivated with praiseworthy industry. Wherever the eye can detect the smallest patch of verdure, there some hardy mountaineer will be found ready to drive up his cow to the solitary spot, for the sake of the feed; or if beyond the reach of the four-footed beast, he will himself ascend, mow the grass, and binding it in bundles either carry it down on his back, or drag it to the nearest precipice, and roll it over into the plain below, where he can secure it on his descent. Several of the cantons have with great success introduced a scheme of free agricultural education, with the view of bringing about a better and more scientific system in the various practical operations of cultivation, farming, &c.

It is calculated that, including cows, horses, sheep, and goats, no less than 1,500,000 cattle are annually fed on the mountain pastures of Switzerland. In certain cantons there are very strict rules in connection with the grazing of these animals; legislation even descending to such particulars as to determine the exact number of beasts that may be sent to feed on each separate pasturage.

As the wealth of a mountain canton is calculated by the number of cows nourished on its heights, it becomes an object of watchful care to prevent if possible the encroachments made on the pastures by the fall of avalanches, which, carrying in their descent fragments of rocks, stones, and loose earth, cover the ground, and destroy all vegetation. These avalanches frequently occur in spring, and the devastations they make are only prevented by such precautions as raising barriers to divert their course, and especially in guarding from the woodman's axe those forests which, situated above, serve as a natural protection to the green swards beneath. Yet the woods are frequently destroyed in order to procure fuel; and then the climate below having depended on them, becomes colder, and reacts on the vegetation, which directly seeks a lower level.

In winter the population of the Alps inhabit villages scattered over the lower valleys. In May the cattle are led to the pastures; in July they ascend the regions 6000 feet above the sea; and about the 10th of August they graze on the highest mountains, whence they descend to the valleys about the 10th of October. Few individuals have such a number of cows as would repay the labour of attending them in the summer on the mountains. The practice, therefore, is for parishes to hire herdsmen and assistants to take care of them while there, and make the butter and cheese in the rude wooden huts or *chalets* in which the former reside: they have scarcely any furniture except the necessary dairy utensils. The owners get credit daily for the quantity of milk furnished by their cows; and the produce of the sale of cheese at the end of the season, the expenses being deducted, is divided among them in proportion to the total quantity of milk furnished by each.

Property in Switzerland is very much subdivided. This arises from the fact that, except in a few districts, where local customs exist to prevent the too great division, the property of individuals is at their death divided in equal shares among their children, without respect to sex or seniority. In the west the alpine pastures are mostly private property; in the east they generally belong to the cantons, being apportioned among the different parishes, each having its alp or common pasture for its cows.

Among the plants grown in Switzerland are flax and hemp; the former especially occupies some portion of every little farm, its bright blue blossoms forming a pleasing contrast to the green vines or verdant fields between which they bloom. A great deal of tobacco is grown in the cantons of Fribourg and Vaud, though not nearly enough for the consumption of the country, which, in comparison with its population, is enormous. Switzerland is also rich in fruits, which form no unimportant part of its produce; and as Swiss experience has decided that the trees do not injure the grass lands, every available meadow within reach of surveillance is planted with cherry, pear, apple, and plum trees. These trees grow at elevations as high as 2800 feet, and in some places to 3600 feet. Large quantities of cider and kirschwasser (from cherries) are made. But of all the fruit trees in which Switzerland abounds, the vine occupies the most important position, and is looked on as by far the greatest agricultural product of the country. The cantons in which it is most cultivated are those of Vaud, Zürich, St. Gall, Aargau, and Schaffhausen. Olive trees grow only in some favoured spots in the canton

of Tessin, where also the fig and peach trees bear abundantly, as well as in some parts of the lower Valais. The forests of Switzerland occupy about 18 per cent. of the entire area, and as there is scarcely any coal, wood is used almost exclusively for fuel, and in many places also for building purposes. Timber-cutting thus forms one of the chief employments of the people. The trees are deprived of their boughs, and shot with inconceivable rapidity over the slopes into the valleys below, from which they are transported by the rivers to different parts of the country, and also to France and Germany.

The Swiss cows are very handsome animals, and so valuable that even in that country they fetch a high price. They yield more milk than those of Lombardy, where they are in great demand. The best cattle are those of Simmenthal, the district of Saanen, and the cantons of Fribourg and Soleure, the last being especially remarkable for the excellence of its oxen. The sheep are mostly of inferior breeds, and the wool short and coarse. Goats are fine and numerous in the highlands. Pigs are plentiful in the forest cantons. They are a large, but coarse breed. The horses, though not handsome, are strong and spirited, and well adapted for cavalry and artillery service, for which they are exported to France and other countries. Mules are bred in the south cantons, where they are mostly used for the conveyance of passengers and merchandise. The breed of alpine spaniels kept by the monks of St. Bernard is much celebrated on account of the wonderful sagacity they display in rescuing travellers from the snow. The convent or hospice of the Great St. Bernard is situated at a height of 7963 feet above the sea, near the summit of the mountain pass, and in a region where the most severe storms, accompanied with avalanches, frequently occur. These dogs, which are strong and active animals, are trained by the monks to the task of seeking out travellers who may have lost their way over the mountains, or been benumbed by the cold; and this they accomplish with wonderful instinct and sagacity, being furnished with the means of rendering assistance to the wayfarer by a basket of provisions fastened round the neck, or some similar contrivance.

Among wild animals were formerly bears and wolves, both in the Alps and Jura, but the former are seldom heard of except in the severest winters, and the latter are growing very rare. The chamois is found chiefly among the loftiest mountains of the Alps; wild boars are not uncommon in the cantons of Bern, Vaud, and Aargau; stags in the canton of Bern and occasionally in the Grisons; badgers, foxes, hares, marmots (valued for their fur), otters; birds of prey of large dimensions—one of them, the lammergeyer (lamb-destroyer), is said to be the largest native bird in Europe—and many varieties of winged game are also met with. The lakes and rivers are well supplied with fish, among which are several kinds of salmon, found chiefly in the Rhine and the waters connected with it; salmon trout of large size, chiefly in the lakes of Constance and Geneva; and common trout in almost all the rivers and lakes. The only insects deserving of notice are bees, the rearing of which forms an important occupation in several cantons; and silkworms, almost confined to the canton of Tessin. Here, too, are found vipers, the only venomous reptiles of the serpent kind known to Switzerland, and some scorpions.

Manufactures, Trade, Railways, Telegraphs, and Post Office.—Although, according to the census of 1880, there are 1,138,678 individuals supported by agriculture, either wholly or in part, Switzerland is and has been a considerable manufacturing country for centuries. In the canton of Zürich the making of silks, taffeta, serges, silk handkerchiefs,and ribbons, gives employment to a large population. The cantons of St. Gall and Appenzell have important manufactures of cotton cloths, embroidery, cotton prints, leather, linen, glass, and jewelry. The city of Basel forms another emporium of trade and manufactures principally of silk ribbons, silk thread, taffeta, and satins. Leather, paper, and tobacco are also manufactured. Schaffhausen has manufactures of steel and files, which are in great repute; cotton spinning and cotton printing are also carried on. Geneva is a great mart of trade and industry. The manufactures consist chiefly of watches, jewelry, and musical boxes; but include also cabinet-work, saddlery, lithography, and engraving, cutlery, firearms, enamels, &c. The chief industrial occupations in the canton of Neuchâtel are—cotton printing, lace-making, and watchmaking, which prevails greatly among the highlands of the Jura. The manufacture of watches and jewelry is also carried on in Vaud, Bern, and Soleure. The inhabitants of the cantons of Thurgau, Glarus, and Aargau manufacture cotton cloth, prints, and muslins of all descriptions, hosiery, silks, and ribbons. In Aargau linen and cutlery are also made. Straw-plaiting employs a large number of persons in the cantons of Aargau, Lucerne, and Basel. In very many cases agricultural labour is combined with factory work and handloom weaving.

No operatives in Europe enjoy such excellent schooling as the Swiss, and every opportunity is afforded them of perfecting themselves still further after they have left school. Politically and socially all are on a footing of equality, education is alike for all, and wealth is very evenly distributed. As political life presents few attractions to the wealthier classes, the greater number devote themselves to manufacturing industry, which renders a more remunerative return. In no other country are land and property so equally divided among the mass of the people. The principle of decentralization is carried to its extreme point, and everything is done by mutual voluntary assistance, friendly combination, and co-operative societies, in which masters, workmen, and indeed all classes, meet on an equal footing and in the most fraternal spirit to devise schemes for the general welfare. The Swiss operative lives in his own home surrounded by his family, and at spare times cultivating his own land, while the Swiss agriculturist in his leisure hours works at some handicraft or trade, such as watchmaking, weaving, toy-making, or wood-carving. The women are not exempt from field work, not even in the families of very substantial peasant proprietors. All work as regularly as the poorest male individual. The land, however, being their own, they have a choice of work, and the hardest is generally done by the men. The females also appear to have a far more important *rôle* in the family among the lower and middle classes than in England. The mutual relations between masters and men in Switzerland are excellent, and though they have in some few instances been disturbed, it has always been due to foreign agitators; and the result of considerate benevolence on the part of employers is visible in the almost invariable good conduct and laboriously conscientious work of the men. The societies existing for purposes of public usefulness are innumerable, and comprehend every conceivable scheme which can improve the social and material interests of workmen and peasantry. None of these, however, are "charitable" in the English acceptation of that word. Nothing is given as alms, but all the various societies are maintained on the principle of mutual aid, secured by the co-operation of all classes according to their means. This mutual good-will and sympathy which exists between the two classes may be attributed to various causes, but there is no doubt that a powerful element of content is found in the natural, sound, practical sense, economy, industry, and self-restraint of the people. The Swiss workman understands that Swiss industry can only compete successfully with that of other countries on two conditions—moderate profits for the capitalist, low wages for the labourer; and he comprehends that the interests of the employer are identical with those of the employed. The Swiss are often accused of being mercenary, and the charge, very possibly,

is not unjust. English tourists are well aware that their demands at inns and for guides are often only limited by their notions of what they may be able to obtain; but there is no inconsistency in this. Common sense tells them in which case large profits are possible and *vice versa*, and they act accordingly.

The manufactures of Switzerland and a small quantity of cheese and wine are carried to distant countries through Germany, Holland, France, and Italy. The imports consist chiefly of corn, salt, salt fish, raw silk, and cotton, colonial produce, and the different metals required for watchmaking. Notwithstanding its insular position, Switzerland has long been the most commercial country on the Continent in proportion to its population. From returns in 1887 it appeared there were about 2000 miles of railway open for traffic, and all the important parts of the country are connected with each other.

The system of telegraphs in Switzerland, like that of Belgium and the United Kingdom, is under the control of the state, except some private wires used by the railway companies. The Swiss system now includes 4300 miles of line and 10,386 of wire. An important feature in this system is the arrangement between the authorities, by which money orders may be sent by telegraph instead of by post.

Constitution and Government.—The settlement of 1815 left the tie between the cantons extremely loose, and even the constitution of 1848 left the cantons in the possession of many of the functions of free and sovereign states. For more than twenty years after this Switzerland enjoyed a period of tranquillity, during which time there was a remarkable development of all the inconveniences and mischiefs to which this system leads. In twenty-two cantons there were twenty-five distinct civil and criminal codes. The most primitive modes of punishment existed, while capital punishment was abolished in some places and retained in others. The administration of justice was arrested at every step by different laws and modes of procedure, and a man could not be held answerable in one canton for the debts, the marriage, or other legal obligations contracted in another. In the ultra-republican districts a Swiss of any other canton found himself as much a stranger as if he were in China, and the most vexatious obstacles interposed against his naturalization, and against his exercise either of political rights or of any trade or industry. There naturally arose a party who advocated the removal of these absurd anomalies by a closer union among the cantons, and who demanded that Switzerland should be made a nation, not a mere confederation of semi-sovereign states. The majority, however, were for letting well alone, clung to their idealized cantonal independence, and pointed out that at least there was a common bond of union in the military arrangements, and that any menace to the country from without would produce at once the needful organization and discipline. The events of the Franco-German War of 1870–71 dispelled this fond illusion, and showed the utter helplessness to which the country had been reduced by its constitutional system. Twice during the struggle of 1870–71 occasion arose for mobilizing the federal forces or a portion of them. The military arrangements then proved to be utterly unequal to provide any force fit to take the field. Viewed even as militia, the troops were comparatively worthless, and General Herzog, in reporting to the federal council on the event, stated that the infantry battalions furnished him by the cantons were some of them in such a condition as "must make the heart of any patriot sad."

Such a humiliating exhibition brought home the weakness of the constitution very forcibly, and its reform now became certain, though it was not until 1874 that prejudice was so far overcome as to enable amendments to be carried by a majority. The constitution of 1874 inaugurated a vast reform, and although based on the fundamental laws of 1848, made serious changes in the constitution then adopted. The present one made Switzerland a homogeneous nation, raised it to the rank of a respectable military power, equalized its laws, established secular and compulsory education, deprived the priests of much of their power and privileges, and completely subjected ecclesiastical authority to the civil power. Every citizen was made liable to serve in the army, the right to call them out and dispose of them being given to the central authority. The warlike material—arms, stores, fortifications, &c.—were claimed and transferred to the central government, whose supremacy was clearly defined and established. In religious matters the changes were of equal importance, but these and others will be noticed in their place.

The new constitution came into force May 29, 1874. It vests the supreme legislative and executive authority in a parliament of two chambers—a "Ständerath," or State Council, and a "Nationalrath," or National Council. The first is composed of forty-four members, chosen by the twenty-two cantons of the Confederation—two for each. The "Nationalrath" consists of representatives of the Swiss people, chosen in direct election, at the rate of one deputy for every 20,000 persons, according to the latest census.

A general election of representatives takes place every three years. Every citizen of the republic who has attained the age of twenty years is entitled to a vote; and any voter, not a clergyman, may be elected a deputy. Both chambers united are called the "Bundes-Versammlung," or Federal Assembly, and as such represent the supreme government of the republic. The chief executive authority is deputed to a "Bundesrath," or Federal Council, consisting of seven members, elected for three years by the Federal Assembly. Every citizen who has a vote for the National Council is capable of becoming a member of the executive.

The president and vice-president of the Federal Council are the first magistrates of the republic. Both are chosen by the Federal Assembly for the term of one year, and are not eligible for re-election till after the expiration of another year. The appointment takes place at a united meeting of the State and National Councils. The members of the Federal Council, each of whom has a salary of £480 per annum, while the president has £600, act as ministers or chiefs of the seven administrative departments of the republic. The Federal Assembly alone has the right to declare war, to make peace, and to conclude alliances and treaties with other nations.

Independent of this assembly, though issuing from it, is the "Bundes-Gericht," or Federal Tribunal, which consists of nine members, elected for three years, and decides, in the last instance, all matters in dispute between the various cantons of the republic, as well as between the cantons and the Federal Government. It also acts in general as high court of appeal. The tribunal is divided into three sections, the "Anklagekammer," or chamber of accusation; the "Kriminalkammer," or jury department; and the "Cassations-Gericht," or council of judges.

Each of the cantons and demi-cantons of Switzerland has its own government, different in organization in most instances, but all based on the principle of absolute sovereignty of the people. In a few of the smallest cantons the people exercise their powers direct, without the intervention of any parliamentary machinery, all male citizens of full age assembling together in the open air, at stated periods, making laws and appointing their administrators. Such assemblies, known as the "Landesgemeinde," exist in Appenzell, Glarus, Unterwald, and Uri. In some other cantons the legislative bodies are limited so far that they must submit all their acts to the people for confirmation or refusal. In the others the people delegates its

sovereignty to a body chosen by universal sufferage, called the "Grosse Rath," which exercises all the functions of the "Landesgemeinde." The members of these bodies, as well as most of the magistrates, are either honorary servants of their fellow-citizens, or receive a merely nominal salary. No class of paid permanent officials exists, either in connection with the cantonal administrations or the general government of the republic.

The bankruptcy and other laws have been made uniform in all the cantons, and the constitution of 1874 abolished the penalty of death, but in 1879 it was decided that each canton should have liberty to re-enact the infliction of the penalty, and Lucerne and Uri have done so.

Population.—The following table gives the area and population of each of the twenty-two cantons, according to the enumeration taken in 1880:—

Cantons.	Area: Eng. Sq. Miles.	Population, 1880.
Graubünden (Grisons),	2,774	94,991
Bern,	2.660	532,164
Wallis (Valais),	2,026	100,216
Vaud (Waadt),	1,245	238,730
Ticino (Tessin),	1,095	130,777
St. Gallen,	780	210,401
Zürich,	665	317,576
Luzern,	580	134,806
Fribourg (Freiburg),	644	115,400
Aargau,	542	198,645
Uri,	415	23,691
Schwyz,	351	51,235
Neuchâtel (Neuenburg),	312	103,732
Glarus,	267	34,213
Thurgau,	382	99,552
Unterwalden,	295	27,348
Solothurn,	303	80,421
Basel,	177	124,372
Appenzell,	162	66,799
Schaffhausen,	116	38,348
Genève (Genf)	109	101,595
Zug,	92	22,994
Total,	15,892	2,846,102

In 1887 the population was estimated at 3,000,000. At the last census 2,030,792 spoke German, 608,007 French, 161,923 Italian, and 38,705 Roumansch. The number of foreigners resident in Switzerland was 211,035, of whom 95,262 were German, 53,653 French, 41,645 Italians, 12,735 Austrian, 2812 British, 1285 Russian.

Church and Education.—The population of Switzerland is divided between Protestantism and Roman Catholicism, about 59 per cent. of the inhabitants adhering to the former, and 41 per cent. to the latter. According to the census of 1880, the number of Protestants amounted to 1,667,109; of Roman Catholics to 1,160,782; and of Jews to 7,373. The alpine region is almost entirely Roman Catholic. Complete and absolute liberty of conscience and creed exists, and the constitution of 1874 declares that "no one can incur any penalties whatsoever on account of his religious opinions." Ecclesiastical encroachments are jealously guarded against, an amount of power, in fact, being invested in the civil authority in this respect such as does not exist elsewhere in Europe. It can interfere in all matters relating to the creation of new religious communities, or the division of old ones; no new convents are to be founded or old ones enlarged, and no bishoprics created without permission of the state. The performance of marriage cannot be refused on any grounds of religion or morality; and children born before marriage are legitimatized by the marriage of their parents. The former constitution rigorously excluded the Jesuits from every part of the republic, and the new one extends the exclusion to all other religious orders "the conduct of which is dangerous to the state, or disturbs the peace between creeds." In matters ecclesiastical and educational, as well as military, the new constitution relieved the central authority from all cantonal restrictions, and its jurisdiction in these respects extends to every part of Switzerland.

A system of compulsory education has existed theoretically in the country for some years, but it has only been practically carried on in the Protestant cantons. The chief difference made by the constitution of 1874 was in laying upon the central authority the duty of enforcing the observance throughout the country of one uniform law of compulsory secular education. Parents are compelled to send their children to school, or have them privately taught, from the age of five to that of eight years. No person can exercise the rights of citizenship, or in many cases obtain employment, unless he has received a certain amount of instruction; and it is, in fact, rare to meet with any one who cannot read and write. In every district there are primary schools, in which the elements of education, with geography and history, are taught; and secondary schools for youths of from twelve to fifteen, in which instruction is given in ancient and modern languages, geometry, natural history, the fine arts, and music. In both these schools the rich and the poor are educated together, the latter being admitted gratuitously. There are superior gymnasia in all the chief towns. Basel has a university, founded in 1460, which was formerly much frequented; and universities are established in Geneva, Bern, and Zurich. In the Protestant cantons especially there are numerous literary, musical, and scientific societies, and a very large number of political journals and periodicals.

The German element is ruling in sixteen out of the twenty-two cantons, among them being the two leading ones, Zürich and Bern.

Revenue and Expenditure.—The public revenue of the Confederation is derived chiefly from customs dues. Some other sources of income, as the profits derived from the postal system, conducted also by the Federal Government, and of some national property, are of no great importance. The chief part of the postal revenue, as well as a portion of the customs dues, have to be returned to the cantonal administrations, in compensation for the loss of these items of income since they have been collected by the central government. In extraordinary cases the Federal Government is empowered to levy a rate upon the various cantons after a scale settled for twenty years. A final source of revenue is derived from the profits of various federal manufactories, such as gunpowder and percussion caps, and from judicial and other fees. The revenue and expenditure of the Confederation are each over £2,300,000 a year. The public debt amounts to about £1,400,000. As a set-off against the Swiss debt, however, there is a "federal fortune," or property belonging to the state, valued at 50,000,000 francs or £2,000,000. The various cantons have their own local budgets of revenue and expenditure, the former being raised chiefly by a kind of property-tax and the sale of excise licenses.

Army.—The fundamental laws of the republic forbid the maintenance of a standing army within the limits of the Confederation. The constitution of 1874, however, enacted that "every Swiss is liable to serve in defence of his country," and the military forces were at the same time placed more thoroughly under central control. The children of the schools are also taught "such gymnastic exercises as are a proper preparation for military service."

The troops of the republic are divided into two classes, namely:—

1. The Bundesauszug or Federal army, consisting

of all men able to bear arms, from the age of twenty to thirty-two.

2. The Landwehr or militia, comprising all men from the thirty-third to the forty-fifth year.

The numbers of the various classes in actual readiness to take the field were given in the latest official return as follows:—

	Men.
1. Bundesauszug, ...	114,928
2. Landwehr, ...	85,826
	200,754

Both the Bundesauszug and reserve are called out for periods varying in the different grades from fourteen to forty-five days annually; and periodically the troops of several cantons assemble for a general muster. There is thus no standing army, and very few officers are permanently appointed or paid. The neutrality of the country is, it is true, guaranteed by Europe, but the ability it now possesses to inflict a serious blow on an invader is a much more satisfactory security, and one more likely to insure active help from outside. The total cost of the army in 1886 was about £700,000, the new and more elaborate regulations under the revised constitution having caused a considerable increase upon its former cost.

History.—Switzerland in the time of the Romans was inhabited by two distinct races, the Helvetians, probably of Celtic origin, who occupied the north-west, and the Rhœtians, who dwelt in the south east. It was absorbed into the all-embracing Roman Empire, and adopted the Roman usages, laws, and language. But when the Roman domination fell, Helvetia was invaded by three German peoples, the Franks, the Ostrogoths, and the Burgundians (450). The latter, towards the close of the fifth century, embraced Christianity, which had already been established some 200 years at Geneva, Coire, and other places, and which, by the close of the seventh century, had spread over the whole extent of country now known as Switzerland.

About 550 Helvetia became by conquest a portion of the great Frank Empire, though retaining its ancient laws and customs. When the empire was partitioned among the Merwing princes, Helvetia was divided between two sovereigns, one reigning over the Franks and Ostrogoths, and the other over Little Burgundy. Pippin reunited them, and his illustrious son, Charles the Great, laboured zealously to promote the prosperity of the country. Under his feeble successors, the principal landed proprietors, the judges of certain districts called *gaus*, who themselves were named *grafs* or counts, succeeded in throwing off the royal authority and in making their power and privileges hereditary. One of these, Rudolf, established in 888 the new kingdom of Burgundy, between the Reuss and the Jura, which about thirty years later was strengthened by the annexation of Arles. The other counts maintained their independence until about the middle of the tenth century they were compelled to acknowledge the supremacy of the German emperor. And after the death of Rudolf III. (1032), the fifth and last king of Burgundy, the whole of Switzerland was subjected to the imperial sceptre of the Emperor Conrad II.

Under his grandson Henry IV. the imperial authority was once more overthrown, and feudalism ruled triumphant. Against the oppression of the nobles, however, the merchant and citizen classes united, and Geneva, Zürich, Basel, and Lausanne became prosperous and independent towns. Gradually two among the feudal families attained to supremacy over the others; the Hapsburgs in Northern Helvetia and the counts of Savoy in the south-west, owning but a nominal allegiance to the German crown. It was natural that in this state of things the cities should look to the monarchy as their bulwark against a tyrannical obligarchy, and the monarchy, to weaken the power of the nobility, gladly espoused the cause of the cities, many of which, as Zürich, Berne, Basel, Uri, Schwyz, obtained seigneurial rights, and assumed the name of imperial cities or imperial districts.

In 1273 the crown of Germany devolved on Rudolf of Hapsburg, a Swiss nobleman, whose enlightened policy greatly favoured the growth of these opulent commercial communities. His son Albert, however, was jealous of their independence, encroached upon their rights, and attempted to reduce them into subjection. He was defeated. His tyranny gave umbrage to the so-called Forest cantons or districts, and encouraged by the success of their countrymen they resolved to expel their Austrian bailiffs or landvögte. For this purpose their principal burgesses assembled in the famous field of the Rüth on 7th November, 1307, under the leadership of Fürst of Uri, Stauffacher of Schwyz, and Melchthal of Unterwalden, and formed the first confederacy of the Swiss cantons. They swore to preserve their ancient privileges, and resolutely declared war against the overwhelming forces of Austria. The legend of TELL enshrines the fervid patriotism of the time with all the splendour of poetical myth. The struggle which followed was keen and desperate, but it was decided in favour of the Swiss by the battle of Morgarten, where 10,000 men under the Emperor Leopold I. were totally defeated on 16th November, 1315, by 1300 mountaineers.

For some years the Swiss cantons were unmolested by external enemies. A dread of Austrian power, however, induced them to cement still closer their defensive alliance, and the League was joined by Luzern in 1332, completing the famous quartet of the "Vier Waldstätter," or League of the four Forest Cantons. Zürich, which soon became the head, joined in 1351; Glarus and Zug in 1352, and Bern in 1353. The number of Cantons was now eight, and so remained for 128 years; and even after other cantons were admitted the eight enjoyed special privileges all down to 1798. Soon after 1350 the emperors renewed their designs against Swiss independence and encouraged jealousy in neighbouring princes, so that a league of 176 barons, with Duke Leopold at their head, burst upon the Confederation, and were with difficulty resisted. At the crowning battle of Sempach the serried ranks of the barons' spearmen were irresistible till Arnold von Winkelried rushed upon them and gathering as many spears as he could as he fell opened a breach through which his comrades victoriously rushed in (9th July, 1386). Leopold lay among the slain. The men of Glarus won another victory at Näfels in 1389, after which the Austrians made peace. Relieved from foreign pressure the cantons quarrelled among themselves, and to resist the ambitious claims of Zürich, the Caddu, or League of God's House, was formed by the Grisons in 1400. It lasted until 1419. A second league of the Grisons, called the Ligue Grise or Grey League, was concluded about 1424, and a third, the League of the Free Jurisdiction, in 1436. The predominance of Schwyz at this time was such as to have given the country the name by which it is known in modern times, and the heraldic shield which it still bears as its national ensign.

From these intestine conflicts the Swiss were diverted by the lust of territorial conquest. Boldly launching themselves against the imperial armies, they invaded, in 1415, Aargau and Thurgau, which they speedily overran and annexed. Three years later they crossed the Alps and conquered Ticino. To protect himself from these hardy mountaineers the Emperor Frederick III. sought the help of France, and a French army invaded Switzerland. The Swiss illustrated their history with the glory of a second Thermopylæ at St. Jacob on the Birs, near Basel, where a body of 1600, intrenching themselves in a churchyard,

withstood the attack of 30,000 French, under the Dauphin Louis (afterwards Louis XI.), and perished to a man (26th August, 1444). The French lost 10,000 men and were compelled to retreat. Charles the Bold, duke of Burgundy, a man of ungovernable ambition and haughty temper, now proposed to crush the daring republicans, who had given him some trivial cause of offence and had defied his menaces. He led into Switzerland a finely equipped army, but was defeated at Granson on the 5th of April, and at Morat his army of 35,000 men was annihilated on the 22nd of June, 1476. In his distress he sought and obtained the aid of the Duke of Lorraine, and the two princes again encountered the Swiss at Nancy, 5th January, 1477. They were totally defeated, and Charles the Bold fell on the field of battle.

In 1481 the towns of Fribourg and Soleure, or Solothurn, with their dependencies, were admitted as two new cantons (the ninth and tenth) into the successful confederacy. Eighteen years later the Emperor Maximilian I. made a final attempt to establish the imperial dominion over them. In the war which followed the Swiss gained six victories, and the emperor, baffled and beaten, concluded peace in 1499. Basel, Appenzell, and (in 1513) Schaffhausen were admitted into the confederacy, and the confederated thirteen states were now universally recognized as an independent European power.

From this time the Swiss entered on a career of mercenary soldiership, fighting for whatever state was willing to hire their services. They conquered Lombardy for Maximilian Sforza in 1512, and beat the French at Novara in 1513. After the great battle of Marignano, however, won by Francis I. against them in 1515, they concluded a perpetual peace with France, confirmed by the alliance of 1521, and a Swiss corps thenceforward formed a regular part of the French military establishment. It is but just to acknowledge that their fidelity towards their foreign masters was unimpeachable. When Louis XVI. was dethroned his Swiss guards were faithful among the faithless, and shed their blood in defence of the fallen throne with heroic valour.

The era of the Reformation was a period of intestine tumult and dissension in Switzerland. Zwingle began to preach against the enormities of the Church of Rome in 1518, and found a willing audience at Zürich, which became the headquarters of Protestantism. His doctrines were also adopted by Bern, Basel (where Œcolampadius was their expounder), Schaffhausen, St. Gall, Bienne, and Mulhausen. Thus Switzerland saw itself divided by religious differences into two hostile camps, the Reformed and the Catholic, the latter including Uri, Luzern, Schwyz, Unterwalden, Zug, Fribourg, and Soleure. In Appenzell, Glarus, and the Grisons the inhabitants were nearly equally divided between the two creeds. The trumpet of fanaticism soon rang out the tocsin of a civil war. A Protestant preacher was burned by the Schwyzers. Zwingle was slain in an engagement at Cappel, in which 8000 Catholics carried all before them, and Zürich was crushed (1531). Two armies, each about 30,000 strong, mustered in defence of their respective beliefs, but happily a wiser spirit prevailed, and both sides laid down their arms. The jealousy of the cantons, however, allowed Constance, which desired admission to the confederacy, to slip for ever, by falling in 1548 under the sway of Austria; and Geneva, Strasburg, and Mulhausen were also driven off by this fatal exclusiveness. During the Thirty Years' War Switzerland, under the control of Bern, which had become the leading state, maintained a skilful neutrality, and by the Treaty of Westphalia, in 1648, was acknowledged as an independent state.

Yet, virtually, French influence was paramount in several of the cantons, until their jealousy was aroused by the erection of the fortress of Huningen in 1679. During the persecution of the French Protestants towards the close of the reign of Louis XIV., the Swiss supplied them with pecuniary aid and offered an asylum to their fugitives, nor did they suffer themselves to be intimidated by the threats of the French government.

For upwards of a century Switzerland enjoyed complete external tranquillity except for occasional religious contests. The most important of these saw for a short time 150,000 Swiss in arms threatening a disastrous civil war, but the danger happily passed away (1712). Her barren mountains, however rich in majesty, possess little to tempt the ambitious, and favoured by so prolonged a peace, she achieved considerable triumphs in the fields of literature, art, and science. That her sons were worthy to compete with the eminent men of France, Germany, and Italy will be admitted by the reader who recalls the memory of Haller, Bernoulli, Rousseau, Lavater, Gessner, Fuseli, Pestalozzi, and Von Muller. Yet the heart of a nation is apt to be corrupted by unimpeded prosperity. Bound together by no dread of a foreign foe, the different cantons quarrelled among themselves. In some the government was gradually usurped by a few privileged families; and it cannot be denied that at the outbreak of the French Revolution extensive discontent prevailed. This terrible convulsion, however, hushed all minor differences. On the borders of Switzerland rose an ambitious and unscrupulous military despotism, and French force and French intrigue soon destroyed the vaunted independence of the different cantons. Portions of Switzerland were incorporated into the territory of France, and the confederacy was converted into the Helvetic Republic, one and indivisible, under an executive directory of five persons, on the model of that of France. The legislative power was divided between a senate and a great council, to which each of the fourteen cantons, which resulted from the extensive rearrangements of territory now made, elected twelve members. A gallant attempt was made in 1802 by Aloys Reding to restore the independence of his country, but it was speedily crushed by the preponderant force of the French, and Napoleon in 1803 assumed the title of Mediator of Switzerland, which he oppressed by conscriptions and pecuniary exactions of the harshest character. The old thirteen cantons were once more restored. Several of the subject territories were at the same time raised into separate cantons, as Aargau, Thurgau, Vaud, and Ticino. The hitherto allied, but not confederated, states of the Grisons and St. Gall followed, and the number of cantons was thus nineteen.

In 1814, at Napoleon's fall, the free independence of the confederacy was once more acknowledged, and in the following year a new constitution was agreed upon between twenty-two cantons; Neuchâtel, which belonged to Prussia, Geneva, and the Valais, being the three which now joined the confederacy. But as this constitution was oligarchical in principle, and gave no expression to the voice of the people, it was received with little favour by the masses. The general demand for reform was unexpectedly strengthened and enforced by the French Revolution of 1830, and the aristocratic party found it expedient to give way. The new constitution, however, retained one great defect—the weakness of the central power (or Diet), which is still liable to be attended with serious disasters in any sudden emergency. Basel divided itself into two "half cantons," called Basel City and Basel Country, in 1832, and this division yet exists. The long sacred right of asylum was partially abrogated by Switzerland owing to the pressure of the great European powers in 1834 and 1838; but when this was put to the test by a demand for the extradition of Prince Louis Napoleon (afterwards Napoleon III.), who had been for several years a citizen of Thurgau, the Swiss were ready to go to war rather than submit. The prince voluntarily left the country rather than submit it to this trial (1838).

The next remarkable event in Swiss history was the civil war of 1847 between the Protestant cantons, with their Free Corps, and the Ultramontane cantons, with their Sonderbund. The Jesuits having instigated various reactionary measures, the Liberal party insisted on their expulsion, and after a fierce struggle succeeded in carrying their point (1844–47). The Catholic cantons were mulcted in the expenses of the war, the Jesuits were expelled, the monasteries were suppressed, and some important reforms were introduced into the administration (1848). Later in the same year Neuchâtel rebelled against the King of Prussia as Prince of Neuchâtel, declared itself a republic, and adopted a constitution similar to that of the other Swiss cantons. The Prussian king protested, but finding European public opinion against him, refrained from supporting his protest by arms, and Neuchâtel joined the confederacy (1857). During the Italian and Prussian wars of 1859 and 1866 and the Franco-German War of 1870 Switzerland preserved her neutrality, and no noticeable incidents have occurred in her recent history except the disagreement with France in 1862, which was amicably settled, the election riots at Geneva in August, 1864, and the centralizing revision of the constitution in 1874. The confederation, as at present established, still includes the two and twenty cantons. The supreme legislative and executive power resides in two chambers; the first is a state council of forty-four members, two from each canton, elected triennially, and the second is a national council of 145 members, chosen one for every 20,000 electors. The executive rests with a cabinet of seven members. In 1873 there was a long dispute with Rome, ending in the expulsion of the Nuncio Mermillod and the formation of a Swiss National Catholic Church. Upon Monsignor Mermillod being appointed in 1883, by the Pope's authority, bishop of the united sees of Geneva, Fribourg, and Lausanne, the federal council quashed the appointment, and the dispute was forcibly brought to an end. Thus the ancient jealousy of interference still shows its power even against so venerated an authority as that of Rome. Full religious liberty is given in every canton; and civil marriage, with registration, has been compulsory since 1875, those who wish it adding a religious ceremony, as is usual in France and many other Roman Catholic countries.

SWORD, a weapon used for cutting and thrusting, the origin of which dates from prehistoric times. The earliest weapons used by man in his combats with wild animals or with his fellows appear to have been stones and clubs, and the first piercing or stabbing weapons were probably the pointed horns of the animals killed. When men learned to sharpen and polish flints, among the tools and weapons fabricated short daggers found a place, and these formed a pattern for longer and better weapons, which were afterwards made of bronze. All historic nations seem to have passed through the bronze age, and bronze swords are referred to in the earliest writings of which we have any knowledge. The ancient Egyptians, who possessed the art of imparting to bronze extraordinary hardness and elasticity, employed this material for swords and daggers, the former being straight weapons from 30 to 36 inches in length, having generally a double edge, and tapering to a sharp point. The Assyrians also used bronze swords, heavy and broad in the blade, two-edged, and without a guard. The Greeks in the heroic age had several varieties of swords of bronze, and at a later age of iron. As delineated upon extant coins, vases, &c., they appear to have been short cut-and-thrust blades, leaf-shaped or tapering from hilt to point, and provided with a scabbard, which was attached on the left side to a belt suspended from the shoulder or (more rarely) round the waist. The Lacedemonian sword was curved on the sharp side, while the back was blunt, and the end was pointed obliquely towards the back. The sword (Heb. *chereb*) used by the ancient Hebrews does not appear to have been either a heavy or a long weapon. That which was used by Ehud in the assassination of the King of the Moabites was short enough to be concealed under his clothes, and in the combat with Goliath David seems to have had no difficulty in using the sword of a man so much larger than himself. The numerous references to the sword in the Old Testament show that the weapon was carried resting upon the thigh, that it was made bright and glittering, and that when not in use it was carried in a sheath (Ps. xlv. 3; Job xx. 25; 2 Sam. xx. 8, &c.) The Romans at first used the Gallic sword, which was a cutting weapon, only having one edge and no point, but after the battle of Cannæ they adopted the Spanish sword, which was a short, straight, cut-and-thurst weapon. The Roman *gladius*, made of well-tempered steel, was a very effective weapon, with its short strong heavy blade, which was straight and pointed and furnished with cutting edges. It was worn on the *right* side, hanging from a sword-belt. Instances to the contrary are few, but in the arch of Septimius Severus at Rome three soldiers by exception are found to wear their swords on the left side. This may, of course, have been an error of the sculptor, or an improvement of the design at the sacrifice of accuracy. At this period also the swords were tending to become longer and more pointed (as compared, for instance, with those on Trajan's Column), but in the succeeding ages of Constantine the Great, &c., the reverse tendency was indulged in, and very short blades indeed were the fashion. The Saxons used short swords at first, but some specimens found in the grave mounds at Brighthampton were about 3 feet long, and were strong straight blades with a double edge and broad point. During the mediæval period swords were made with wide, strong and straight blades, for the purpose of cutting through or piercing the defensive armour worn, the hilt being usually made in the form of a cross and used as a religious emblem. With the gradual disuse of armour the shape of the sword was altered, and single-edged, pointed weapons came into fashion, the hilts being worked into various basket patterns for the protection of the hand.

In the sixteenth century the development of the art of fencing led to the gradual disuse of the cutting sword as a weapon to be carried by gentlemen, the rapier, designed only for thrusting, taking its place in personal encounters, the heavier, edged weapons being reserved for war. The rapier attained its full development during the seventeenth and eighteenth centuries, and it has not yet wholly lost its place in the settlement of personal quarrels among certain continental peoples. At the present day the army swords of the western nations are designed to guard the user, to be good for cutting, and to have the power of making an effectual thrust. In some cases a straight blade is adopted, but most army sabres are made slightly curved, though not so much so as to impede their pointing power, are stiffened by grooves, edged on one side along their length, and flattened at the point, where for a few inches both edges are sharpened. Among Eastern nations curved swords with fine cutting edges have generally been preferred to straight blades, and the Turkish scimitar, the Persian and Central Asian swords, and the Indian tulwar are extensively curved. In these the edge is always kept very keen, and the drawing-cut is their most effective stroke. Some of the Marhatta swords, however, are quite straight, and the Arabs prefer swords of the old Crusader pattern, while the Chinese swords, two of which are carried in the same sheath, are short, straight, two-edged, and pointed. The Japanese, who have always held the sword in honour, are splendid sword cutlers, and many of their swords are of historical interest, having been handed down as precious heirlooms for many generations.

Many plans have been tried for imitating the peculiar wavy appearance on the surface of Damascus blades, but

it is not known whether any of them are identical with the original practice. Besides this *damascening* or *damasking*, as it is termed, several ingenious processes are resorted to for ornamenting sword blades by etching and embossing, and by inlaying them with gold and silver wire; an art to which the name of *damascening* is sometimes applied. See RAPIER; SABRE; SCIMITAR.

In modern warfare the white weapon has been relegated to a subordinate place, and even cavalrymen are beginning to mistrust its powers. The troopers of the United States carry swords for parade purposes, but when they are engaged in warfare they rely upon rifle and revolver. In the war in the Soudan the British cavalry found the sabre a very ineffective weapon, and after a skirmish or two the men took to using the native spears in preference. For fighting at close quarters, however, a good sword must always be a useful weapon, and it is improbable that it will ever fall wholly into disuse while man remains a fighting animal.

With respect to the manufacture of swords, several countries have at different times been celebrated for the excellence of the weapons made by the inhabitants. Perhaps the most famous swords were the Damascus blades of the middle ages, made probably of East Indian wootz or cake steel, and after these came the swords of Toledo and Milan. Swords of good repute are still made at Toledo, but the manufacture is a small one and does not employ many persons. Swords were made at an early period in England, but they never enjoyed any high reputation until towards the close of the eighteenth century, when Mr. Gill of Birmingham manufactured some very excellent weapons for the East India Company. At the present day the process generally employed in sword making is as follows:—The material of the blade should be cast steel of the very best quality, with a grain as fine as silk. The bar of steel is carefully heated in the fire, and is then hammered on the anvil into a wedge shape. When the blade is required to be concave upon the sides, or to have a reeded back, or some similar ornament, it is hammered between steel bosses or *swages*. When shaped, it is hardened by heating it in the fire until it becomes dull red, and then dipping it point downwards in a tub of cold water. When taken out, the metal is white in colour, hard, and brittle, and it has to be tempered by drawing it through the fire several times until the surface exhibits a bluish oxidation. It is then set or straightened by placing it on a sort of fork upon the anvil, and wrenching it by means of tongs in the direction required to correct any degree of warping which it may have contracted during the hardening. The grinding is performed upon a stone with either a flat or fluted surface, according to the kind of blade; and as the uniformity of the temper is impaired by this process, it is subsequently restored by a slight heating, after which the blade is glazed with emery, and if the instrument be a fine one, with crocus martis, after the manner of a razor blade. The sword is then ready for the hilt or handle.

Among the tests to which sword blades are subjected in order to prove their flexibility and elasticity, is that of bending them into a curve by pressing the side of the blade against six or eight pegs or stout nails driven into a board, in such a manner that, when in contact with all the pegs, the middle of the blade may be bent 6 or 7 inches from a straight line drawn between the point and the hilt. A further test is applied by an apparatus consisting of a vertical pillar rising from a board. The point of the sabre is placed upon the board at the foot of the upright pillar, and the hilt is then pressed down until the middle of the blade bends away from the upright piece to the required degree; the amount of curvature being shown by a peg which projects horizontally from the pillar, about midway between the top and the bottom. The temper is also proved by striking the blade smartly upon a table on both sides, and by severe strokes with the back and edge upon a block. At the manufactory of Toledo each sword is thrust against a plate in the wall, and so bent into an arc forming at least three parts of a circle. It is then struck edgeways upon a leaden table with all the force which can be given by a powerful man holding it with both hands. The polishing is performed upon a wheel of walnut wood.

The swords made by Messrs. Wilkinson of Pall Mall, London, are tested by striking the flat side on an iron table, and the back and edge upon a block of oak, the point being driven through a plate of iron one-sixteenth of an inch thick. A good sword is a rather expensive article, a fair price for a trooper's sabre with the scabbard being from 30*s.* to 40*s.*, while a good officer's sword properly mounted will cost £5. The regulation swords of the British army, however, are supplied by the contractors at much lower prices, and as a rule they are weapons of the most inferior quality. The swords used in the Soudan were described as bending like hoop-iron, and more recently, the cutlasses supplied to the navy were found so soft that they could be readily twisted into the shape of corkscrews. See "The Book of the Sword" by Richard F. Benton (London, 1884).

SWORD OF STATE is the sword borne before the monarch, lords, and governors of counties, &c. Four swords are used at the coronation of a British sovereign, viz., the Sword of State properly so called; the Sword of Mercy, which is pointless; the Sword of Spiritual Justice; and the Sword of Temporal Justice.

SWORD, ORDER OF THE, a Swedish military order of knighthood, founded by King Gustavus Vasa, and still held in some repute.

SWORD-FISH (Xiphiidæ) is a family of fishes belonging to the order ACANTHOPTERYGII, distinguished by having the upper jaw produced into a long sword-like weapon, formed by the prolongation and coalescence of the maxillary and intermaxillary bones. The species are not numerous, and are found in the open in all tropical and subtropical seas. The Common Sword-fish (*Xiphias gladius*) is abundant in the Mediterranean and extends along both sides of the Atlantic; it is occasionally taken on the coasts of Britain. The body, which in the full-grown fish is from 10 to 14 feet in length, is elongated, rounded behind, and somewhat compressed in front. The upper part of the head is flat or slightly convex, the profile gently falling; the sword is finely toothed at the edges, the upper surface marked by minute striæ, and the under surface smooth, with a slight mesial groove. The pectoral fins are elongated, and attached low down on the body, the first three rays longest, the last shortest; the ventral fins are wanting; the dorsal fin commences on a line with the gill-openings. In adult specimens the middle part of the dorsal fin is often so much worn as to be almost obliterated. The head and body are covered with a somewhat rough skin, the roughness being caused by the minute form of the scales. The upper parts are of a dirty blue colour; the under parts are of a fine silvery white. Its food consists chiefly of other fishes, though probably it feeds on marine vegetation also; in the stomach the remains of squids are sometimes found. The flesh of the full-grown fish is hard, but not disagreeable; that of the young is white, good, and nutritious. Yarrell, in describing the mode of capturing them in the Mediterranean, says:—"A man elevated on a mast, or on a neighbouring rock, gives notice by signal of the approach of a fish. The fishermen row towards, and attack it with a small harpoon attached to a long line, and are so skilful as often to strike the fish at a considerable distance. The struggle then commences, which is, indeed, whale-fishing in miniature. Sometimes they are obliged to follow a fish for hours before they are able to get it into the boat. The fishing season is from May to August."

The sword is a very formidable weapon, and conflicts are

said to frequently occur between these fishes and large whales, in which the former generally come off victorious. The sword is sometimes driven into the bottom of boats and ships (which are perhaps mistaken for a whale) with such violence that it cannot be extricated, and remains broken off in the timber. In the British Museum may be seen the broken sword of a sword-fish embedded in a piece of a two-inch plank of a whale-boat. The young fishes undergo great changes during growth, the dorsal fin being at first high and greatly elongated, the lower jaw at first equalling in length the upper, and the whole skin being covered with small rough excrescences.

The sword-fishes found in the Indian and Pacific oceans belong to the genus Histiophorus, which is distinguished by the presence of ventral fins in the form of long styliform appendages, and by the small teeth found in the jaws and on the palatine bones. These species are known as flying sword-fishes from the size of the dorsal fin, which, when erected, projects above the water in such a way as to serve, it is said, as a sail.

SYB'ARIS or **SYBARITA,** a Greek city in Lucania, in Southern Italy, situated between two rivers, the Crathis (Crati) and the Sybaris (Coscili). It was a colony founded about the year B.C. 720 by Achaioi and Troizênoi. Sybaris soon increased in wealth and power, for at the time of its greatest prosperity, that is, about 200 years after its foundation, it had, according to Strabo, acquired dominion over four neighbouring tribes, had twenty-five subject towns; the city itself occupied a space of 6 miles in circumference, and its inhabitants were enabled to send an army of 300,000 men into the field, a number which seems quite incredible. Sybaris became the mother of other colonies, such as Poseidôneia, and carried on a considerable commerce. But its prosperity had a pernicious influence on its people, and within the short period of 210 years that it existed their effeminacy and luxury were carried to such a pitch that the name Sybarite became proverbial and synonymous with a voluptuous person. It would be tedious to repeat all the gossip of Athênaios about the extremity to which the Sybarites carried the pursuit of luxury; but we have Aristotle's authority to corroborate one part of his statements, namely, that it was against the law to ply any noisy trade in or near Sybaris, or to make any noise while citizens were asleep, so that among other detailed prohibitions it was penal to keep fowls. In Herodotos a certain Smindurides of Sybaris appears with 1000 cooks, &c., in his train, crossing to Sicyon to sue for the daughter of Kleisthenês (Herod. vi. 27). The probability is that all we read of the effeminacy and luxury of the Sybarites applies to the aristocracy, and that much of it is exaggerated because the city was a recognized butt for satire, and invited the attacks of the witty and inventive by its undoubted folly. The power of Sybaris seems to have been in the hands of an aristocracy, and the struggle between this aristocracy and the commons resulted in a war with the neighbouring Krotôn or Crotona, which espoused the cause of a banished faction, and the contest ended in the total destruction of the city (B.C. 510). In B.C. 441 the colony of Thurii was founded a little to the south of its site. The new colony was composed of a remnant of the Sybarites and of other Greeks, among whom were Herodotos the historian and Lysias the orator.

The site of the ancient Sybaris is uncertain, but it is generally supposed to be near the modern Torre Brodognato or Terra Nuova.

SYB'ARITE. See SYBARIS.

SYC'AMINE is a tree mentioned in the Bible (Luke xvii. 6), which is now identified with the Black Mulberry (*Morus nigra*). See MULBERRY.

SYC'AMORE. See MAPLE and FIG.

SY'CEE (Chinese *se-sze*, fine silk), a term employed to denote the *wanyin* or pure silky-surfaced silver of China, in which the Chinese pay their taxes. For this purpose it is cast into ingots, varying in weight from 175 grains to 5 lbs. troy. The average weight is about 1 lb. troy. As they bear a rude resemblance to a Chinese shoe, they are called *shoes* by foreigners. There are no silver coins cast by the Chinese, and their silver currency is chiefly derived from foreign dollars.

SYCO'NUS (Gr. *sukôn*, a fig), in botany, is the name applied to spurious fruits which, like that of the fig, consist of an enlarged fleshy excavated or concave flowering axis, in which are embedded numerous separate fruits.

SYCO'SIS, a disease of the skin, which consists of an eruption of a crop of pustules, each perforated by a hair, and more or less pointed, rising from a swollen, red, and inflamed surface. The pustules break, the effusion causing prominent crusts, and as a fresh crop appears daily the disease may be prolonged for weeks, months, and even years. It generally affects the hairy portions of the face, and in addition to the disfigurement to which it gives rise, it is usually attended by heat, stiffness, and considerable pain. The causes of this affection are rather obscure, but it is most frequently observed after exposure to inclement weather, and anything that causes inflammation of the hair follicles may give rise to the disease. The treatment of this affection consists in attention to the general health of the patient, and the local use of palliative applications in its early stages, or of stimulant applications when it has become chronic. When the eruption is breaking out the best applications are water dressings, poppy-head fomentations, and cold starch poultices at night, followed by the use of the oxide-of-zinc ointment during the day. For chronic forms of the disease an ointment made by adding two parts of vaseline or benzoated lard to one of the iodide-of-sulphur ointment, is an excellent application. The ointments of the yellow and red oxides of mercury suitably diluted are also useful applications.

SYD'ENHAM, THOMAS, one of the greatest names in the history of medicine, was born, the son of a country gentleman, at Winford-Eagle, Dorsetshire, in 1624. He was admitted a commoner of Magdalen Hall, Oxford, in 1642, but he suffered a temporary interruption of his studies in consequence of that city's being turned into a garrison by Charles I. Some have asserted that Sydenham served for some time with the Royalists during the Civil War; but all his connections were of the popular party, and no evidence can be adduced in proof of his assumed loyalty to the king. His brother William was, we know, a colonel in the Parliamentary army, and filled some of the highest posts of the Commonwealth. It has been affirmed on the other hand, and upon very fair evidence, that Sydenham actually served in the army of the Parliament. He at any rate returned to Oxford after it was surrendered to the Parliamentary forces, and took his degree of bachelor of physic, *honoris causâ*, when Lord Pembroke became chancellor of the university. He resided several years longer, indefatigably pursuing his studies, though he left the university without taking any degree by examination. The facts of his life have unfortunately become somewhat scanty and obscure. From the French surgeon Desault we learn that he resided some time at Montpellier, apparently for the purpose of attending the lectures of the celebrated Barbeyrac. This visit to France must have been made between his leaving Oxford and his settling in Westminster, about 1661. In 1663 he was admitted a licentiate (he was never a fellow) of the College of Physicians. In 1676 he took his degree of M.D. at Cambridge, long after he had been in full practice. Little or nothing is known of his London life, except the mere fact of the almost unexampled distinction he attained as a medical practitioner. It is said that during the reigns of the second Charles and of James he was the reverse of a favourite with the court; nor did the College of Physicians ever regard him with

favour. But in spite of court and college, he rose in a marvellously short time to the top of his profession. Sydenham, who enjoyed the friendship of Locke, Boyle, and indeed of all the best and greatest men of his time, and who was in himself a model of refined culture and unaffected piety, lived through the dismal period of the Restoration, and saw, just before he departed, the liberties of England secured by the ever-memorable transactions of 1688. For many years he had been a great sufferer from the gout, and he died at his house in Pall Mall on the 22nd December, 1689. He was buried in the aisle of St. James's Church, Westminster, where the following inscription may be read:—"Prope hunc locum sepultus est Thomas Sydenham, medicus in omne ævum nobilis; natus erat A.D. 1624: vixit annos 65." Locke, in the preface to his Essay, calls him "one of the master builders at this time in the commonwealth of learning," and ranks him with "Boyle, Huyghens, and the incomparable Newton." Nor can there be any doubt that this conjunction of names points directly to the peculiar, and so far as physicians are concerned, the incomparable, excellence of Sydenham as a man of science. It is his immortal merit that he saw through the quackery of his profession, and left the popular theories to the College of Physicians, while he set himself, as a true disciple of the new philosophy, to the patient observation and interpretation of facts. The two principles according to which he fashioned his practice were, first, that the *vis medicatrix*, the recuperative energy which belongs to every organized being, ought not to be interfered with; and secondly, that symptoms are a language which must be learned and understood before you can possibly know what they say or mean—principles in strict accordance with the Baconian method. Hence he is often styled, with perfect justice, the "father of modern medicine." The following, which are the opening sentences of the preface to his first work, "Observationes Medicæ circa morborum acutorum Historiam et Curationem" (1666), show us the noble spirit in which he addressed himself to the duties of his high calling:—"He who sets himself to the work of curing men will do well to ponder again and again these four things—1st, That he must himself some day render an account to the Supreme Judge of the lives of the sick committed to his care; 2nd, that whatsoever of art or of science he has by the Divine blessing attained to, is to be directed in the main to the glory of God in the highest, and to the welfare of the human race; for it were an unworthy thing that their celestial gifts should be made to serve avarice or ambition. Moreover, 3rd, that he has taken upon himself the charge of no ignoble or contemptible creature; for that we may estimate the worth of the human race, the only begotten Son of God became man, and thus enriched by his own dignity our nature he assumed. Finally, that he is himself not exempted from the common lot, but is subject to the same laws of mortality, and is obnoxious and open to the same calamities and sorrows as others, so that being himself a fellow-sufferer he may the more diligently and with a more tender affection succour those who are sick." Sydenham's writings, which are a collection of Latin tracts and letters, embrace a great variety of subjects. They are all well worthy of being carefully studied, but the best are perhaps those which treat of acute diseases; of the small-pox and other eruptive fevers, the treatment of which he exactly reversed from the old practice, with the most astonishing success; of the epidemic diseases of London from 1675 to 1680; and of the gout, which he studied most exhaustively from his own case. His delineations of diseases have never been, and probably never will be, surpassed. The best Latin edition of these valuable works, which ran through twenty-five editions in one century, is that of Dr. Greenhill, brought out by the Sydenham Society, in 1844; but the same society's English translation (by Latham) is inferior to the fine old work of Swan. An excellent and appreciative account of Sydenham is given in the "Horæ Subsecivæ" of that peculiarly elegant writer Dr. John Brown; and the best edition of Swan's translation is that by Dr. Wallis, in two vols. 8vo (1789).

SYD'NEY, the capital of the British colony of New South Wales, on the east coast of Australia, is situated on the south side of the beautiful bay called Port Jackson. The coast, north and south of the entrance to Port Jackson, consists of sandstone cliffs rising precipitously from the water's edge to the height of 200 or 300 feet. On approaching the land from the east, these perpendicular cliffs appear to be continuous; but on coming nearer, an opening is perceived between two lofty headlands, which are called the North and South Heads. Within these, a point of land, called Middle Head, stretches out from the south side in such a manner as to form a natural breakwater, and completely protect the interior from the easterly winds and the swell of the Pacific. After passing round this head a capacious bay is seen, which extends in a westerly direction about 15 miles from the coast, the width varying from 1 to 3 miles, with excellent anchorage for the largest vessels. This is Port Jackson, which for scenery, capacity, and safety ranks with the finest of all harbours. On either side are coves with wooded shores, besprinkled with neat cottages, homesteads, and villas in ornamental grounds, which, with the vessels continually passing to and fro, form a singularly lovely spectacle. The width of the harbour at Sydney is $1\frac{1}{2}$ mile. Fifteen miles inland, at the head of the bay, there is a creek, 8 miles long, and navigable for boats of 12 or 15 tons burden. At the head of this creek is the town of Paramatta, and the creek itself is called Paramatta River, from a small but constant stream which flows into it.

Sydney is about 7 miles from South Head, and is built partly on the west side of Sydney Cove, one of the numberless bays into which Port Jackson is divided, but chiefly on the low ground, between two rocky promontories, which are separated by three inlets, Farm Cove, Sydney Cove, and Darling Harbour, or Cockle Bay. The principal streets run inland to the south, and are crossed at right angles by others. The Government House and Government Domain limit the extension of the town to the east and north-east: it extends to the south more than 4 miles. A finer situation for a large mercantile city can hardly be imagined. The water is deep, the shores are precipitous, and the wharfs so situated that cargoes can be hoisted from the holds of the largest ships up to the floors of the warehouses. There are several floating docks and large dry docks. The trade of the town is very extensive, as nearly all the exports from and imports into the colony pass through it.

All the best streets of Sydney intersect each other at right angles, and are so spacious that many of them have carriage-ways of not less than 36 feet, and footways of not less than 12 feet wide. They are well paved or macadamized, and lighted with gas. There are numerous public drinking fountains. The houses are substantially built of brick or stone, and many of them have small but neatly-laid out gardens; several of the streets, among which George Street and Pitt Street deserve special notice, present ranges of handsome edifices and elegant shops which may vie with those in most of the great capitals of Europe. Some of the hotels in Sydney are also very fine buildings; and omnibuses and cabs are almost as general as in London or Paris. The city has very extensive and increasing suburbs. A complete system of drainage has been carried out, and there is also a good supply of water. There are several parks—Hyde Park, in the centre of the town, which contains a handsome statue of Captain Cook, inaugurated by the Duke of Edinburgh in 1869; Domain, 138 acres in extent; Prince Alfred Park, Belmore Park, and Moore Park; and a racecourse.

The principal public edifice in Sydney is the university, which is a favourable specimen of collegiate Gothic. It stands on a commanding height, in the centre of a fine inclosure, 150 acres in extent. The principal façade is 500 feet in length. The building was erected at the public expense, and has a permanent endowment of £5000 per annum from the civil list. There is no distinctive religious instruction, and it has both Protestant and Roman Catholic colleges in connection with it. The Government House, built of the white freestone on which the city stands, is in the Elizabethan style, fitted up with the finest colonial marbles in the interior, and with staircases of carved cedar. The Roman Catholic cathedral of St. Mary's is a very fine religious edifice, and so also are the new Protestant cathedral of St. Andrew, and the synagogue completed in 1878. There are numerous churches and chapels, many of them displaying great architectural taste, and the Garden Palace, where the first International Exhibition of Australia was held in 1879-80, is an immense building with a magnificent view. The other buildings deserving of notice are the museum and free library, an exceedingly handsome building, opened in 1870; the colonial secretary's office; the court-house, and adjoining it the gaol; the post-office, opened in 1874—a very fine building in a rather obscure situation; a theatre; the legislative and executive chambers, consisting of a handsome range of stone buildings, with a noble colonnade, forming a verandah and balcony; handsome public hall, capable of accommodating between 5000 and 6000 persons, and having an open roof like that of Westminster Hall; mint, observatory, benevolent asylum, and hospitals: all the charitable institutions are liberally supported—some of them partially from the government funds. The city has a mayor and corporation; it is the residence of the governor, and the colonial Parliament of two houses holds its session here.

Sydney is connected by railway with several towns in the interior, and it has telegraphic communication with all parts of Australia. It is well provided with steam tramways. Coal is procured in the vicinity—the city standing nearly in the centre of the extensive carboniferous basin of Eastern Australia. Numerous factories are at work: these include leather works, boot and shoe factories, clothing factories, and steam-joinery establishments. Sydney is the seat of an Anglican bishop and of a Roman Catholic archbishop, both metropolitans. The branch mint at Sydney coins about £1,000,000 annually. This money was made a legal tender in any part of the British dominions by royal proclamation in 1866. The town is defended by several heavily-armed fortifications, including batteries erected upon Pinchgut Island, a small rock artificially cut to nearly a level with the water.

In 1787 the British government had determined to form an establishment in Australia, in order "to empty the gaols and houses of correction; to transplant the criminals to a place where, by labour, with moral and religious instruction, their conduct may be reformed; to afford at the same time an asylum for free emigrants; and to provide a present relief and future benefit to the mother-country." With these objects in view, Captain Arthur Phillip, of the Royal Navy, sailed from Portsmouth, 13th May, 1787, with eleven ships, intending to settle the colony at Botany Bay, where he arrived 20th January, 1788. Botany Bay, however, was found to be by no means an eligible harbour, being open to the easterly winds, which, whenever they blow violently, roll in a heavy sea from the Pacific; besides which the land was nothing but swamps and sand. Captain Phillip sailed immediately in search of a more suitable place of settlement, and fixed in a few days on the locality of the shores of Sydney Cove, in the bay of Port Jackson, which is said to have derived its name from a sailor of the name of Jackson who first discovered the entrance between the two headlands, and the name of Sydney was given to the new town in honour of Lord Sydney, who was secretary to the colonies at the time Captain Phillip fixed on the present site. Immense difficulties were encountered by the settlers for some time, as they were entirely dependent upon supplies from England, and more than once the whole colony was on the verge of starvation. Transportation ceased practically in 1839, when the last convict ship arrived, and since that time the population of Sydney has rapidly increased. The population of the city proper at the census of 1881 was 99,670; of the suburbs, 120,757—a total of 220,427. The climate of Sydney is on the whole temperate and healthy, and many semi-tropical plants are grown in the vicinity. The mean temperature of the year is 66°, in the coldest month 59°, and in the hottest 73° Fahr. The port is about 12,000 miles from Plymouth by the Cape of Good Hope.

SYE'NE (Gr. *Suênê*), now called Assouan, has been from ages unknown the southern frontier of Egypt. It lies just below the First Cataract. Close by are the quarries of the beautiful rose-red granite, hence called syenite.

The philosophical importance of Syênê was its occupying somewhat the place in ancient astronomy and geography which Greenwich and Paris do in modern. Following the ancient Egyptians, the Greeks, and after them the Romans, all drew their first parallel of latitude through Syênê. Moreover, as the city lay just under the tropic of Cancer, the sun was vertical at the summer solstice at noon, and it was a fact noted by the ancient philosophers that the image of the sun could then be seen in a well at Syênê.

SY'ENITE is a term originally applied by Pliny to a hornblendic granite (*i.e.* a granite in which the mica is replaced by hornblende), largely quarried by the ancients at Syênê, in Upper Egypt. And the name has been employed in most geological works, until quite recently, to designate an igneous rock of a similar character. At the present time, however (following Werner), only those crystalline masses, consisting essentially of felspar and hornblende without quartz, are usually placed under the denomination of syenite.

SYL'LA. See Sulla.

SYL'LABLE (Gr. *sullabê*). A syllable consists of one or more elementary sounds of a language uttered in one emission of voice. The interjection *Oh* is an example of a syllable consisting of one elementary sound; and the syllable *strange* is an example consisting of several elementary sounds articulated (joined) together. Words which consist of one syllable are termed monosyllabic; those consisting of two are termed dissyllabic; those of three, trisyllabic; and those of more than three are indefinitely termed polysyllabic.

Spoken language is a system of audible signs for the expression of thought, and written language is a system of signs to express spoken language, so that written language is two removes from thought. Syllables, both as words and as part of words, belong both to spoken and written language.

In words of more than one syllable, one of them is always made more conspicuous to the ear than the other, by what is termed stress or accent. Stress is produced either by an abrupt percussion of voice, as in the word *pepper*, or by an extended quantity or a swelling loudness of voice, as in the word *amaze*. The stressed syllable of a word is invariably that which receives the modification of voice expressive of sense and feeling, called emphasis.

The English is one of those languages which have arisen from what is called a syllabic alphabet; that is, an alphabet where each sign represents a syllable, as Japanese does to this day. In the archaic Indo-European alphabet, which arose from the Semitic, the consonants alone were marked, the vowels being either omitted or very casually indicated. The result is seen most strikingly in the fact that the Jews to this day know not the name

of God as used by their forefathers, for only the consonants of each syllable remain. They add, therefore, a vowel to each syllabic letter; producing the word which we call JEHOVAH in this way. The name is really JHVH, and no one can say how the syllables really ought to sound which these consonants indicate.

SYL'LABUB, the name given to a confection at one time very popular, but which is now but seldom seen. It consisted of sugar and cream, flavoured with brandy or sherry and lemon rind and juice, worked into a froth and served up in glasses.

SYL'LABUS (Gr. *sullabos*), a compendium, table of contents, or an abridgment, used to indicate an outline of the subjects of a course of sermons or lectures.

SYL'LABUS, the title given to a collected list of eighty propositions, condemned at various times as erroneous by Pope Pius IX., which was sent by his order to the Roman Catholic hierarchy (8th December, 1864). At different periods previous popes had condemned at one and the same time a series of propositions or statements of doctrine held to be heterodox or dangerous, and Pius IX. was moved to a similar act by a pastoral letter issued by Bishop Gerbet of Perpignan in July, 1860, censuring eighty-five propositions taken from various contemporary writers. On reading this document the Pope commissioned some Roman Catholic theologians to draw up a list, with references, of the errors he had denounced during the eighteen preceding years in his consistorial allocutions or in his official letters. This list was annexed to the bull *Quanta Cura*, issued 8th December, 1864, and communicated to the hierarchy by Cardinal Antonelli. The bull and the syllabus were ordered to be taken as one authoritative act, the eighty errors designated in the latter being grouped under ten different heads, including pantheism and its adjuncts, naturalism and absolute rationalism, moderate rationalism and religious indifferentism; twenty propositions adverse to the constitution and rites of the church; seventeen on civil society and its relations to the church; ten on Christian marriage; two on the temporal princeship of the Pope; and four on modern liberalism in its bearings on religion.

The publication of the syllabus caused considerable excitement in Europe, and it gave rise in France to an animated controversy between the government and the hierarchy. On 1st January, 1865, Jules Baroche, the minister of public worship, issued a circular letter to the French bishops, forbidding the publication by them of the syllabus and of the doctrinal part of the bull, declaring the doctrine of the Pope to be "contrary to the principles on which the empire reposed." In spite of this prohibition the Bishop of Belley and the Cardinal-Archbishop of Besançon read both the bull and the syllabus from the pulpit, and were afterwards prosecuted by the government. The government journals and the liberal papers strongly assailed both documents, the articles in the *Journal des Débats* being replied to by Bishop Dupanloup, who claimed to point out over seventy mistranslations and misconceptions on the part of the journal. In other countries, though the action of the Pope was generally condemned by the secular press, the civil governments did not feel called upon to interfere with the bishops in their use of the syllabus. In Germany Dr. Schulte, a professor of canon and German law in the University of Prague, assailed the syllabus in a pamphlet published in 1871, entitled "The Power of the Roman Popes over Princes, Countries, Peoples, and Individuals," assuming that it was an utterance *ex cathedra*, as defined by the Vatican council, and this assumption, as well as his whole argument, was attacked by Bishop Fessler, who had been a secretary of the council, in his "True and False Infallibility of the Popes" (Vienna, 1871; English translation, London, 1875). In the autumn of 1874 the doctrines condemned in the syllabus were again brought prominently before the world by the publication of Mr. Gladstone's pamphlet, "The Vatican Decrees in their Bearing on Civil Allegiance." From the syllabus and the bull *Quanta Cura* he selected eighteen propositions for criticism, bearing principally on the liberty of the press, of conscience, worship, and speech; on the essential rights of both church and state; on education, marriage, the temporal power of the papacy, tolerance, and modern liberalism. The interpretation of the various propositions by Mr. Gladstone, and his conclusions therefrom, drew forth replies from Dr. Newman, Cardinal Manning, and other eminent Roman Catholics; but after a time the controversy was allowed to drop, and it has not since been renewed in any way that has attracted public attention.

SYLLOGISM. Every sentence in which the conclusion is a necessary consequence of previous assertions contained in that same sentence, is a syllogism, provided that the conclusion be obtained from two distinct assertions, and two only. Thus "Some A's are B's, for every B is A," is not a syllogism, though logically true. Every ordinary assertion may be reduced to one of four forms, the universal affirmative, the universal negative, the particular affirmative, and the particular negative. From these, by combination, all syllogisms are derived; and the laws of combination, and the manner of expressing them, constituted that branch of science which is now often turned into ridicule, particularly as to its notation and the strange and uncouth words by which the species of syllogisms were formerly denoted. The following letters always signify the several species of propositions:—

A, the universal affirmative; every X is Y.
E, the universal negative; no X is Y.
I, the particular affirmative; some X's are Y's.
O, the particular negative; some X's are not Y's.

Since every conclusion must be drawn from the comparison of two things with a third, a syllogism consists of two propositions, in each of which the same term occurs compared with another; this term is called the *middle term*. Thus in

Every Y is X,
Every Z is Y,
Therefore Every Z is X,

Y, the subject of the first assertion and the predicate of the second, is the middle term. The two first assertions are the *premises*, the third is the *conclusion*. The predicate of the conclusion is called the *major term*; the subject of the conclusion, the *minor term*: and the major or minor premise is that which contains the major or minor term of the conclusion. The major premise is always written first.

The order of the terms in the premises and conclusion must be either

I.	II.	III.	IV.
YX	XY	YX	XY
ZY	ZY	YZ	YZ
ZX	ZX	ZX	ZX;

and these are called the four *figures*. The first three are in Aristotle, the fourth was by tradition ascribed to Galen, and was called Galenic. In the first figure the middle term is the subject of the major and the predicate of the minor; in the second, the predicate of both; in the third, the subject of both; in the fourth, the predicate of the minor and the subject of the major. Every particular case of a figure is called a *mood*; and since either of the premises may be either of the four species of propositions, A, E, I, O, it follows that there are sixteen moods in each figure, or sixty-four possible moods in all. But of these many are inconclusive, and many moods which admit of conclusion in one figure do not so in another.

If all the sixty-four cases be examined (a most useful exercise) it will be found that the following syllogisms are valid:—

First figure—AAA, EAE, AII, EIO.
Second figure—EAE, AEE, EIO, AOO.
Third figure—AAI, IAI, AII, EAO, OAO, EIO.
Fourth figure—AAI, AEE, IAI, EAO, EIO.

As to figures—Any proposition may be proved in the first; none but negatives in the second; none but particulars in the third; and everything but the universal affirmative in the fourth.

As to moods—From premises both negative or both particular, no conclusion follows: where one premise is negative, the conclusion is negative; and where one premise is particular, the conclusion is particular.

In order to remember the figures, certain words have been long used by writers on logic, which make a grotesque appearance.

First figure—Barbara, Celarent, Darii, Ferio.
Second figure—Cesare, Camestres, Festino, Baroko.
Third figure—Darapti, Disamis, Datisi, Felapton, Bokardo, Ferison.
Fourth figure—Bramantip, Camenes, Dimaris, Fesapo, Fresison.

These are thrown into hexameters for mnemonic purposes—

"Barbara, Celarent, Darii, Ferioque *prioris;*
Cesare, Camestres, Festino, Baroko *secundæ;*
Tertia Darapti, Disamis, Datisi, Felapton,
Bokardo, Ferison *habet; quarta insuper addit*
Bramantip, Camenes, Dimaris, Fesapo, Fresison."

Thus the vowels AAA are seen in *Barbara*, AII in *Datisi*.

And when we say that *Camestres* (AEE) is a valid mood of the second figure, we mean to assert that "Every Z is Y" and "No X is Y" gives "No X is Z" as a necessary conclusion.

Before the fourth figure was in general use its moods were (with order of premises transposed) called indirect moods of the first figure; and the words used to denote them were Baralip[ton], Celantes, Dabitis, Fapesmo, Friseson[orum].

The rules of syllogisms may be briefly condensed as follows:—(1) One at least of the premises must be affirmative, and one at least universal; (2) the middle term must enter universally in one of the premises; and (3) the conclusion must not speak of any term in a wider sense than it was spoken of in the premise in which it entered. A term universally spoken of is either the subject of a universal affirmative, or the predicate of any negative.

SYLPH (Gr. *silphē*, a kind of insect), the name bestowed on the spirits of the air by the fanciful Rosicrucians, and adapted into English by the poets. It was made fashionable by Pope in his "Rape of the Lock," and is now popularly used to denote any light, aerial, and peculiarly graceful being. According to the Rosicrucians, the race of sylphs occupied an intermediate position between material and immaterial creatures, men and spirits. Like the former, they eat, drank, slept, and were subject to human passions; like the latter, they were invisible, with diaphonous bodies and the capacity of swift and facile motion. They possessed no soul, and at death became wholly extinct. They were represented as particularly partial to the human race, and as often seeking wives among our women, in which case their children were invariably human. Pope has very much refined on the Rosicrucian idea. In his poem, however, as well as in the Cabalistic romances, the sylph is a male; but the term has now a feminine signification, owing, we suppose, to the graceful and ethereal nature with which the poet invested his airy creations, while limiting their offices to the guardianship of the toilet, the masquerade, and the boudoir. Pope thus describes them:—

"Some to the sun their insect-wings unfold,
Waft on the breeze, or sink in clouds of gold;
Transparent forms, too fine for mortal sight,
Their fluid bodies half dissolved in light.
Loose to the wind their airy garments flew,
Their glittering textures of the filmy dew,
Dipp'd in the richest tincture of the skies.
Where light disports the ever-mingling dyes;
While every beam new transient colours flings,
Colours that change whene'er they wave their wings.'

SYLVERIUS (Pope). See SILVERIUS.

SYLVESTER I., II., III. (Popes). See SILVESTER.

SYLVESTER, JOSHUA, "the Silver-tongued," was an English poet who flourished in the reign of James I. He was born in 1563, and though he received no university education, he made himself master of several modern European languages. In 1597 he was recommended by the unfortunate Earl of Essex to the company of merchant adventurers at Stade, from whom Sylvester sought the appointment of secretary. His first important work was a translation (1590) of the "Canticle of the Victorie at Ivry," written about 1579 by the French Huguenot noble Salluste du Bartas, at that time considered a worthy rival of Ariosto in style. Sylvester here calls himself "Josua Sylvester, Marchant Aduenturer." His translation in 1598 of Du Bartas' "Divine Weekes and Works," a very popular book in its day, greatly extended his fame. He was appointed court poet to Henry, Prince of Wales, on whose death he wrote an affected poetical lament entitled "Lachrymæ Lachrymarum, or Teares Distilled," which reached a third edition. Scarcely less acceptable to King James were the poet's rhymes against tobacco. His Majesty's "Counterblast to Tobacco" has been printed, together with Sylvester's accompanying poem, the title of which is a perfect model of the later "euphuistic" style, "Tobacco Battered and the Pipes Shattered (about their Ears that idlely Idolise so Base and Barbarous a Weed; or at leastwise overlove so Loathesome a Vanitie) by a Volley of Holy Shot thundered from Mount Helicon." Though a Puritan, verses to his honour by Ben Jonson and by Drayton are extant, as well as by B. Hall and John Vicars, whose lines appear under the engraved portrait of the poet in the folio edition of his Du Bartas, 1641. Many of his smaller poems will be found reprinted in Sir E. Brydges' "Restituta." He died at Middelburg in Holland in 1618.

SYL'VIC ACID, an acid found in ordinary rosin, from which it can be extracted by alcohol. It crystallizes in colourless prisms, having the formula $C_{20}H_{30}O_2$. It melts at 152·5° C. (306° Fahr.), and at higher temperatures sublimes unchanged. It is very soluble in hot alcohol, crystallizing out on cooling. It is insoluble in water, but soluble in acetic acid and in turpentine. It combines with bases, forming crystalline salts insoluble in water, called sylvates, and having the general formula $C_{20}H_{29}MO_2$.

SYL'VIIDÆ is a family of birds belonging to the order PASSERES and tribe **DENTIROSTRES**, containing a number of species well known for their powers of song, so that the term *warblers* is applied to the whole family. The Sylviidæ are birds of small size and of active and lively disposition, feeding chiefly on insects, but sometimes to some extent on soft fruits and seeds. They are confined to the Old World, being represented in America by an allied family, Mniotiltidæ, the American or Wood Warblers. Those found in Europe and Northern Asia are chiefly migratory, passing the winter in the south. The bill is short, slender, straight, and somewhat compressed towards the tip. The wings are moderately long, and the tarsi slender, scutellated, with slender toes and claws of moderate length. The adult birds moult twice a year, in spring and autumn; but the young birds of the year only renew a few feathers in

autumn, so that there is frequently a difference in their winter plumage to that of the adults.

The chief peculiarity which runs through this numerous family is the very small size and delicate structure of its individuals. Excepting the humming-birds we find among these elegant little creatures the smallest birds in creation. The different groups spread over all the habitable regions of the globe, are destined to perform an important part in the economy of nature: to them appears intrusted the subjugation of those innumerable minute insects which lurk within the buds, the foliage, or the flowers of plants; and thus protected escape that destruction from swallows to which they are only exposed during flight. The diminutive size of such insects renders them unfit for the nourishment of the thrushes and the larger insectivorous birds, while their number and variety only become apparent when the boughs are shaken and their retreat disturbed. How enormous then would be their multiplication had not nature provided other races of beings to check their increase? No birds appear more perfectly adapted for this purpose than are the warblers. Their arrival in Great Britain, for the most part, occurs on the first appearance of spring, when the insect-world is called into life and activity by the renewal of vegetation; and their departure towards autumn, when the insect hosts diminish, and consequently no longer require the agency of these little birds to keep their numbers within due bounds.

As different localities are assigned to different tribes of insects, so a similar diversity of haunts is allotted to the various groups of warblers. Thus the gold-crests and wood-warblers confine themselves principally to the higher trees, where they search for winged insects among the leaves, or capture them, like the fly-catchers, when attempting to escape. The reed-warblers and the nightingales haunt the vicinity of waters, or the more dense foliage of hedges, for insects peculiar to such situations. The stonechats, on the contrary, prefer dry commons and wide extended plains, feeding on insects appropriated to those localities (Swainson). Among the well-known British species of warblers are the nightingale, blackcap, garden warbler or beccafico, whitethroat, wood warbler, willow warbler, Dartford warbler, gold-crest, reed warbler, redbreast, redstart, stonechat, whinchat, wheatear, and hedge-sparrow, most of which are noticed separately under their respective headings. See also WARBLER.

SYL'VIUS, ÆNEAS, the baptismal names in their Latin form of Ænea Silvio Bartolommeo de' Piccolomini (1405–64), who became pope under the title of PIUS II. His literary work still remains known under the signature Æneas Sylvius, and is usually referred to in that name, much of it being emphatically unpriestly in its nature. In fact had not Pius II. been gifted with more than a full share of the proverbial vanity of authors, there is no doubt that the literary baggage of the elegant but worldly Æneas Sylvius would have been suppressed. It is fortunate for historians that the Pope was amiably weak towards his own books, since they are valuable contributions to our knowledge of the times.

SYMBOLS, in mathematics, are almost entirely used for the purpose of abbreviation, consequently we have to steer clear of using too great abbreviation on the one hand, which produces obscurity, and of not using enough on the other, which produces superfluity. Generally there is some test which shows when the limit of abbreviation is met. Thus if we wish to signify A multiplied by itself nine times, and we write A^9, we evidently touch the limit of abbreviation. The old method of writing A A A A A A A A A was hardly an improvement in high powers (though it served well in lower powers) upon the original plan of writing out the expression in full.

Distinctions should be made, where possible, upon a system. Thus if small letters denote quantities and large letters denote complicated functions of those quantities, a useful distinction at once arises, and it is wise as well as elegant to use the distinction in all cases if it is made in one. On the other hand when two quantities are related it is unwise to adopt entirely different symbols for them: *e.g.* the object is attained quite as clearly by calling one quantity a and the other a', &c. Analogies should be preserved where possible, and to push abbreviation to such a point as to destroy them is certainly most unwise. A case in point will illustrate this. The analogy between $\Sigma\,\phi\,x\,\triangle\,x$ and $\int\phi\,x\,d\,x$ was very evident and valuable. But it was lost by substituting for the latter, as was at one time constantly the custom, the expression $\int_x\phi x$, saving one symbol only, and robbing the eye of a help to clearness. Consequently Fourier's notation of a definite integral $\int_a^b\phi\,x\,d\,x$ is much to be preferred as a piece of symbolism, though if strictly looked at, it is by no means faultless, because logically we ought certainly to represent the successive integrals of $\int\phi\,x\,d\,x$ by $\int^2\phi\,x\,d\,x^2$, $\int^3\phi\,x\,d\,x^3$, &c. If we were to adopt such a notation as $(\int d\,x)^2\phi\,x$, $(\int d\,x)^3\phi\,x$, &c., we should happily combine the two. Thus $(\int_0^x d\,x)^4\phi\,x$ very neatly represents the fourth integral of ϕx, each integration being made from 0 to x. It will be manifest from the above how much may be done in a quiet way with the accurate choice of symbols.

But whilst true analogies should be perpetuated by symbols, false ones should not be created. That is certainly not a wise saving of time, in spite of its great convenience, which represents the "rectangle contained by the straight lines A B and B C, by the rect. A B . B C." and the "square described upon the straight line A B by A B²," because here we have arithmetical symbols used to express geometrical ideas. It is most unfortunate that the word square belongs to both the geometrical and the arithmetical arts; but that is now too late to lament, although it certainly has produced a heavy crop of mistakes and confusion. Useful geometrical symbols are $\because$ (because), $\therefore$ (therefore), $\triangle$ (triangle), $\angle$ (angle), $|$ (straight line), $\|$ (parallel to), $\perp$ (at right angles to), $=$ (equal to), $>$ (greater than), $<$ (less than), $\|^m$ (parallelogram), $\odot$ (circle), &c. Either $\triangle$s or $\triangle$, and either $\angle$s or $\angle$, are used for triangles and angles respectively.

Mathematical symbols outside geometry are almost always letters in some form or other. Roman letters are chiefly used in capitals, italics in small letters; rarely the converse. The Greek small letters are used, and such of the capitals as are distinctive, as Δ, Γ Φ, Ψ, &c. The Arabic numerals are almost always used. Accents are very valuable, as a'', $a_{\prime\prime}$ &c.; and when over numerous are signified by Roman numerals, as a'''' by a^{iv}, &c. Of signs proper, the arithmetical signs $+$, $-$, $\times$, $\div$, with $=$ (equal to), : (ratio-sign, $a:b$, meaning the ratio of a to b), $\surd$ (square root), $\sqrt[3]{}$ (cube root), &c., and the line of division between the numerator and denominator of a fraction almost exhaust those in ordinary use. There are also used the signs for nothing (0) and infinity (∞), and the integral sign ($\int$), its limits being expressed by small italic letters, as $\int_a^b$.

Specially limited symbols are these:—Capital letters in the calculus, &c., denote functions of small letters. The letters d, $\triangle$, δ, and D are appropriated for operations of the differential calculus, and should not be used otherwise in any place where they might cause ambiguity. The letters x, y, z are always used for co-ordinates, but their use is not at all restricted to them; *e.g.* if co-ordinates are being used together with other values these letters are reserved for the co-ordinates, and other letters or symbols must be used for the remaining purposes. The letter π always means the ratio of the circumference of a circle to its diameter; that is, the quantity 3·14159, &c.; and the letter e is in like manner appropriated to the quantity 2·71828,

&c., the base of the natural system (or Napierian system) of logarithms, while Γ is the functional symbol for the series $1 \,.\, 2 \,.\, 3 \cdots n$. For general functional symbols it is always best to exhaust first $\phi, \chi, \psi, F, f, \phi, \Psi$, the recognized letters for the purpose, before proceeding to use others.

The use of symbols was first extended to what are above called *functions* by Leibnitz and Newton. Before this time symbols stood for magnitudes only; but these great men enlarged the meaning of symbols from the expression of simple numbers to the expression of functions; that is, of processes to be performed on these numbers. The discovery of the differential calculus in its various forms forced mathematicians to consider modes of denoting not results of processes so much as ways of proceeding. The generalizations arising out of the organization which notation gave to processes, led to the use of indefinite and arbitrary symbols of operations. Finally it was observed that the *symbols of operation* (as these higher functional symbols are called) employed in many general theorems, would give simple and well-known relations if their meaning as symbols of operation were forgotten and they were simply considered as ordinary numerical symbols, or in the correct phrase as *symbols of quantity*. The extent to which it is safe to deal with symbols of operation thus separated from symbols of quantity is not yet fully settled, but the calculations hold good in a large number of cases. What is practically done is this: one throws away symbols of quantity from a given theorem, deals in whatever manner is proposed with the symbols of operation, treating them as if they were quantities; then one restores the symbols of quantity to their places, and those of operation to their original meaning; and the result has great presumption in its favour as being true, for many such cases can be tested independently, and are found to bear examination. All the same the method has risk, and is by no means universally applicable. For instance, if $\phi x - x^2$ and $\psi x - x^3$, and if $\phi + \psi$ be taken as representing $x^2 + x^3$, it might be supposed that $\phi + \psi$ performed twice, or

$$(x^2 + x^3)^2 + (x^2 + x^3)^3$$

represented by $(\phi + \psi)^2$, should be the same thing as

$$\phi^2 + 2\,\phi\psi + \psi^2, \text{ or } (x^2)^2 + 2\,(x^3)^2 \text{ and } (x^3)^3.$$

This however is not the case, and thus it appears that a line is to be drawn distinguishing operations which may be used independently of quantities from those which may not. The nearest approach to this line is in a memoir by Servois, included in Lacroix' great work on the calculus (Lacroix, vol. iii., p. 726), where the author succeeds in showing that at all events those differences, differentiations, and multiplications by factors which are independent of the variables, may be used as if their symbols of operation were common algebraical quantities. This definition includes most of the operations which are universally regarded as safe in their results.

SYMBOLS, BOTANICAL. Certain marks and abbreviations are in common use among botanists in describing plants, with the view of conveying information in a condensed but easily intelligible form. Those in general use are:—

♂ = male flower.
♀ = female flower.
⚥ = hermaphrodite flower.
A = annual plant.
B = biennial plant.
♃ or P = perennial plant.
Sh = shrub.
T = tree.

The time of flowering is represented by the figures, either Arabic or Roman, from 1 to 12, referring to the months.

Many other signs are found in systematic works, but their meaning is not constant, and the sense in which they are used is generally explained by the author.

SYMBOLS, CHEMICAL. See NOTATION, CHEMICAL.

SYM'MACHUS, QUINTUS AURELIUS, a distinguished Roman orator, belonged to the last half of the fourth century and the beginning of the fifth. He was very carefully educated in Gaul, which had the most famous seminaries of learning at that time, and imbibed a strong love of literature. Symmachus filled some of the highest offices in the state, was quæstor and prætor, pro-consul of Africa, and a member of the pontifical college. He was one of the last defenders of heathenism, and for a time breathed life and vigour into the literature of a religion which was fast expiring. The senate appointed him in 382 to expostulate with Gratian for removing the altar of Victory from the Senate Hall, for which the emperor banished him to the distance of a hundred miles from Rome, and until Gratian's death he continued an exile. Being afterwards prefect of the city, he wrote to Valentinian about the restoration of the pagan deities (384). St. Ambrose, bishop of Milan, successfully opposed Symmachus. In 391 he was made consul by Theodosius, although he had assisted his rival Maximus, such was the respect this excellent man knew how to inspire. The time of his death, which was after 404, is unknown. Symmachus was a man of great abilities, upright, honest, firm, mild. He lived in difficult times, and amid general corruption preserved the character of a high-minded statesman. His extant works consist of letters and fragments of speeches. The letters, divided into ten books, were published by his son after the father's death. The style is good, but laboured, after the model of Pliny. Fragments of nine orations were discovered by Mai in palimpsests at Milan and Rome, and are contained in "Scriptorum Veterum nova Collectio," &c., vol i., 1825.

SYM'MACHUS, ST., Pope from 498 to 514, during the Gothic kingdom of Italy under the great Theodoric, was the successor of Anastasius II., whose chief aim had been to reunite the churches of the East and the West. At the death of Anastasius the party of orthodoxy determined to overturn his concessions and elected the rigid Symmachus, while the party of conciliation elected Laurentius as pope. The rival popes and their factions disputed the throne with great bitterness, quarrels were incessant, and blood flowed in the streets. Finally, the wise Theodoric interposed; and by his declaration that he should support Symmachus on the double ground of priority of election and majority of supporters calmed the storm. The new pope at once passed two decrees, one forbidding all canvassing or reception of promises for the next vacancy in the papal chair, and the other declaring the will of the majority of the people of Rome paramount in the election of a Pope.

Theodoric visited Rome in great state during the rule of Symmachus, and, Arian though he was, performed all his religious duties with the Pope officiating. It was only under the successors of Symmachus that the religious discords began which embittered the close of this great king's glorious reign. In 503, however, religious troubles arose from another source. The party of Laurentius brought several accusations against the Pope with the intention of procuring his deposition. Among them was the horrible charge of adultery. Theodoric summoned a synod of Italian ecclesiastics, who met several times, Rome being throughout in a constant condition of riot. Eventually the synod declared the complete innocence of Symmachus, and he ruled the church with considerable success till his death in 514. He was succeeded by Hormisdas. The last decade of Symmachus was a period of blessed peace and prosperity to sorely tried Italy, such as she did not again enjoy for a very long time.

SYMMACHUS, the head of the Senate about ten years

later, whose execution by Theodoric is almost the only blot on that wise king's administration, was no relation to the Pope of the same name. The senator was the father-in-law of Boethius (author of the "Consolations of Philosophy," a very favourite book in the middle ages, and the last genuinely Latin writing); and as Boethius had suffered for participation in a plot against Theodoric headed by the Pope John and joined in by almost all the chief Romans, the king seems to have feared that Symmachus, though hitherto loyal, might become a traitor from revenge. He therefore suddenly summoned Symmachus to Ravenna and had him executed (526). It is said by the historian Prokopios, who is of course a very hostile witness, that this crime was the cause of the death of Theodoric. For, says Prokopios, as he sat at supper, a large fish placed before him took the shape of the head of Symmachus, and the frightened king, now seventy-six years old, was unable to resist the shock. He turned deadly cold, and nothing was sufficient to restore him to warmth. He died, if we are to believe Prokopios, bitterly lamenting his crimes towards Boethius and Symmachus.

SYM'METRY is that part of the general sense of form which relates to proportion and balance. It may be described as the rhythm of order, in the same way as rhythm is fairly describable as the symmetry of accentuation. In most cases symmetry depends upon the equipoise of parts, as when one balances a statuette at one end of a shelf by something of about the same dimension, probably by something of the same nature, at the other. But it is quite easy to find examples both in nature and in art where a work is equipoised without being symmetrical. We therefore find that symmetry must in its essence be regarded rather as a harmony of proportions relatively to the whole work than as a balance of one part with another. The derivation (Gr. *sun*, together, *metron*, measure), shows that the latter sense was the original, as it is still the most common one; and this is natural, for balance is a much more rudimentary perception than harmony.

SYMMETRY OF ORGANS. This expression is used in popular biology to indicate the result of the repetition of identical parts in the same animal or vegetable form. It is employed in a very general way, and is not intended to include more than such harmony of parts as at once catches the eye. For example, if we take the vertebral column in man as being in the middle line of the body, the organs on each side are said to be symmetrical, though the reader will scarcely need to be reminded that, as in the case of the hands, &c., the symmetry is not absolute and perfect. In like manner, if we regard the midrib, say of the elm leaf, as the dividing line, the venation on each side of this line is said to be symmetrical, even though considerable differences might be observed on a closer inspection of the leaf. The idea underlying this repetition of parts in animal forms has been carried into classification by Professor Owen and other systematists. Thus among the Evertebrata, or animals destitute of a vertebral column, one group is named Heterogangliata, or such as have the system of nerves unsymmetrical, and another Homogangliata, or those in which the nerves are symmetrically developed on each side of the great nerve chord. The former group includes the Mollusca, the latter the Insecta. Attempts have also been made to indicate the leading subkingdoms from this point of view. Thus the lowest, or Protozoa, are held to show no median line and no composition of parts. But this negative mode of characterization is not satisfactory, even when applied to such low forms as Gregarina, for example, in which strictures and internal septa may be observed, while Rhizopods and Sponges present parts yet more distinctly marked, if the whole substance be taken into account. An approach to symmetrical arrangement appears in the next subkingdom, the Cœlenterata, but the exceptions are so many that it may be questioned whether or no it is expedient to lay down as a rule that, in animals of this group, the parts are arranged symmetrically round a logitudinal axis. The same remarks apply to the other subkingdoms, with the exception, perhaps, of the Vertebrata. As far, then, as classification is concerned, the relation of organs to each other, when regarded in the light of their form and use, affords a far safer basis for generalization than their relation to some line or plane in the body. It will thus be seen that the phrase "symmetry of organs" can only be used to indicate that general harmony of different parts which may be observed in all healthy animal and vegetable forms.

SYMPATHETIC NERVOUS SYSTEM. See Nervous System.

SYMPATHETIC VIBRATION. One vibrating body has power to set in motion another whose mode of vibration is synchronous with its own. Thus, if two clocks with equal pendulums be hung upon the same wall and one of them be set going, its vibrations communicated by the wall will soon start the other. The individual shocks are of the slightest, but they occur in a definite rhythm and their action is cumulative, finally amounting to force considerable enough to set a clock going. A very heavy church bell can be rung by a boy if he pulls the ropes at proper and regular intervals, though the strongest man could not move them by sheer force of pull.

But the most complete examples of the power of accumulated periodical impulses are drawn from sound. The very rapid vibrations of the air which give us the sensation of sound as they beat upon the ear are quite impossible to feel, and yet if they continue but a very short time they are able to move bodies of considerable weight under conditions of like vibrating periods. Nearly every church has one or another window-pane which the organist can cause to rattle by playing a certain note; and a good story, all the better for being absolutely true, is told of a somewhat hot-tempered musician who habitually revenged himself upon the churchwardens for any slight, real or imaginary, by breaking a particular pane of a particular window, which he could always do by playing one deep note on the organ. A theoretical musician relieved the officials from the tyranny of his practical brother by throwing that pipe very slightly out of tune, and thus destroying the exact synchrony of vibrations on which the whole depended; and thenceforth, quarrel as they would, the churchwardens were safe as regarded their glass. So great is this resonant capacity that very powerful singers can often crack bell-shaped glasses by singing one of their proper tones into them. But without resorting to such a demonstration any one can convince himself of the reality of this phenomenon by many simple experiments. If two tuning forks be taken of precisely identical pitch, and one of them be placed upon a proper resonance box, then the other fork, upon being sounded and held near the first, will set it in vibration, the impulses being conveyed in this case simply through the air. This is a particularly striking experiment, because the fork which is struck is practically inaudible at a small distance, but when it is brought near the stationary mounted fork the vibrations of the latter are powerfully assisted by its resonance box, and are heard all over the room. Sound appears to arise from silence. Again, two strings may be stretched upon the sonometer and tuned accurately to the same pitch; then if one is set into vibration by a violin bow, the other vibrates also, as is shown in some cases by sound, in all cases by the behaviour of paper riders, which will be unhorsed if placed anywhere but exactly at the nodes of the string, just as they would be upon the string which is made to sound by the bow. To make this experiment more vivid the sounded string should presently be tuned a wave or two sharp or flat to its fellow, when the phenomena at once cease. The like

failure will occur with the tuning-forks upon one of them being loaded with a tiny pellet of wax, which throws it out of vibration with the other.

A remarkable effect of sympathetic vibration of a peculiarly delicate kind is given by singing a strong note upon a definite vowel into the exposed strings of a vertical pianoforte from which the front and the action have been removed. The strings will not only return the tone of the performer, but the precise vowel he has sung. [See VOWEL QUALITIES OF TONE.] The whole phenomena of RESONANCE depend upon this power of sympathetic vibration, and they are dealt with in their proper place.

It remains here to notice the musical use made of sympathetic vibration strictly so called, apart from the resonance of sounding-boards and hollow chambers, &c. This use is daily diminishing, although even as late as 1885, at the International Inventions and Music Exhibition, London, one manufacturer of pianofortes was found so far behind the age as to use a fourth string tuned to the octave, lying above the three strings of the ordinary note of a grand pianoforte. What effect the sympathetic vibration of this octave string had was of course an unmixed evil, strengthening the first partial at the expense of the prime tone, and therefore rendering the quality of the tone thin and wiry. [See ACOUSTICS.] In bygone days, however, the use of sympathetic strings was great. The viola d'amore, for example, had seven strings of catgut and seven fine wire strings beneath the finger-board tuned in unison with the first, and set into sympathetic vibration by them, and the larger viola di bardone often had as many as sixteen or twenty, and in rare cases even as many as forty-four sympathetic strings of metal, though the playing strings (catgut) were usually six and never more than seven in number. Of course the more sympathetic strings there were, the greater was the number of tones reinforcible by them. It is somewhat surprising that the inequality of tone between the reinforced notes and those which were not reinforced, or were less powerfully reinforced, was not felt to condemn the practice of using sympathetic strings. Their effect is to render the tone thin and very sensitive.

SYM'PATHY is an emotion which presents considerable difficulty to the psychologist. Why should a person be affected by the feelings of others, both painful and pleasurable, when these do not directly affect his own welfare? For in sympathy we are engaged with another's experiences or interests, and do not refer to ourselves. The origin of the emotion is undoubtedly personal, because without kindred experiences of our own we cannot properly measure those of others. Everyone knows how unconsciously brutal an animal man sometimes may be towards a nervous, delicate, sensitive woman, hurting her tenderest feelings without meaning to do so, because he, in his rude boisterous health, has no conception of her fragile state. It is proverbially the poor who are the most generous friends of the poor; it is those who have known deep sorrow who are the most soothing ministers in affliction. Sympathy, in fact, is dramatically representative in its nature. An unimaginative nature can hardly be thoroughly sympathetic.

On the other hand no emotion can so easily be stimulated as sympathy. The intense dramatic instinct of children, their love of stories and games with a meaning to them, are acted upon by the judicious teacher as so many sources for developing sympathy. Coupled with the childish passion for imitation, this dramatic instinct of children enables the parent to lead the child on to the performance of noble and unselfish actions through sympathy. The child conceives the pain of others by reasoning upon similar pains of his own, and then, seeing the pleasure his parents take in ministering to that pain, he also imitatively follows the lesson.

Sympathy in itself is not particularly noble, but only becomes so as a source of action. It is the great engine of moral progress whereby we are able to help ourselves and others, doubling our joys and halving our woes. Even if it remains a pure emotion, however, never passing into action, and therefore so far useless (as is often the case with novel readers and votaries of the theatre), it is yet a proof of high culture, or at least of capacity for culture; for (1) a sympathetic person—and the phrase must be taken as applying equally to pleasure and to pain—must have a keen and varied susceptibility; (2) must be a close observer, as the feelings of others, especially of adults, are often closely veiled, and betray themselves by minute touches, easily escaping notice; (3) must have an accurate memory and a vivid imagination, so as to recall the actually-felt and to project the mind into the similarly-imagined; and (4) must be to a certain extent unselfish, altruistic, or at all events not self-absorbed, the self-analysing, brooding nature being by constitution non-sympathetic. Long observation has shown how much easier it is to fall in with another's pain than with his happiness, and this is the source of the sweetness of revenge. No man hurts us by his suffering, but many gall us by their happiness, which we may think undeservedly greater than our own. In fact, as the great-minded Jean Paul Richter nobly said, "It is enough if a man feel sympathy for sorrow; to enter into another's happiness is the part of an angel" (Zum Mitleiden genügt ein Mensch; zur Mitfreude gehört ein Engel).

It follows from what has been said that sympathy is a plant of slow growth. Children are intensely selfish, or rather egoistic, and what sympathy they have is a strictly mutual emotion, giving back something against something received. The emotion, if cultivated by noble surroundings, grows from this humble beginning until the youth becomes capable of self-sacrifice. But it is in old age, when it crowns a virtuous life of conscious aspiration, that sympathy rewards its possessor. The old man whose decaying faculties prevent him from having many personal joys, lives again in his grandsons, and if he has been careful to fight against the narrowing tendencies of senility, he is rewarded by the interests and pleasures of wide-embracing, all-aiding, all-comprehending sympathy, unencumbered as he now is by the needs of personal character, since his own part has been played. Such a venerable age, wielding a power for good which is incalculable, is well worth the life-long struggle against egoism necessary to attain it.

SYM'PHONY or **SINFO'NIA** signifies a musical composition on the lines of a sonata, but for a full band of instruments. Up to the latter part of the last century, the word was synonymous with *Overture;* symphonies, and among them several of Haydn's early ones, being called overtures. Even at the present day the overture in the composer's score of an Italian opera is usually termed *Sinfonia*. The modern symphony generally consists of four movements: a brilliant allegro, which is commonly preceded by a slow introduction; an expressive adagio or andante; a minuet with its trio; and a finale. Instead of the minuet a short, animated, sportive movement, which is called a *scherzo*, is sometimes substituted. But composers are not restricted by any rule regarding the number of movements. Mozart's second symphony in D has but three, besides the slow introduction; while Beethoven's Choral symphony may be said to comprise no less than six, and Rubinstein's Ocean symphony has a greater number still.

Symphony is a term also applied to the instrumental introductions and terminations of vocal compositions; and these are sometimes called ritornels, from the French *ritournelle*, or the Italian *ritornello*.

SYM'PHYTUM. See COMFREY.

SYM'PIEZOM'ETER (Gr. *sumpiezo*, I compress, and *metron*, a measure), an instrument invented by Adie, of Edinburgh, for measuring the weight of the atmosphere by the compression of a gas. It is a glass tube, about 18 inches long, bent slightly at both ends, and with an enlarged bulb about 2 inches long and half an inch in diameter at both ends. The top is hermetically sealed, the bottom can be stopped by a cork. The upper part of the tube is filled with hydrogen or some other permanently elastic gas, and the lower with a fixed oil, or with glycerin, or some gas which the air does not act upon, and which, in its turn, does not act upon the hydrogen.

The tube being open at the lower end, the oil is exposed to the pressure of the atmosphere, and rises to a height in accordance with the difference of the pressures of the atmosphere and of the column of inclosed gas. The greater the atmospheric pressure the higher the oil will rise, owing to the compression of the gas. The change in the bulk of the gas is measured by a scale, which is, however, formed experimentally, and whose divisions are wholly arbitrary.

But a change of temperature as well as of pressure will alter the bulk of the inclosed gas, and some correction is therefore necessary. With this view a common thermometer is applied to the instrument to indicate the temperature; and the barometric scale, which marks the compression of the gas, slides upon another scale so divided as to notate the change of bulk in the gas produced by a change of temperature under the same pressure, and answering to the graduation of the thermometer. In making an observation the observer first notes the temperature by the thermometer. An index, or pointer, attached to the top of the sliding scale, is then set opposite to the degree of temperature on the fixed scale, and the number on the sliding scale opposite the top of the oil column records the atmospheric pressure in inches of the mercurial barometer. The sympiezometer was formerly much used at sea as being more sensitive than the mercurial barometer. Its use has now been discontinued for some years because of its liability to get out of order.

SYMPLOCAR'PUS is a genus of plants belonging to the order AROIDACEÆ. The species are not numerous, and consist of herbs growing in wet places in North America and Northern Asia. *Symplocarpus fœtidus* (skunk-weed or skunk-cabbage), a native of North America, is so called from its offensive garlic-like odour; its tubers are acrid, but when dried and powdered are antispasmodic. It is considered an excellent remedy in asthma, catarrh, and chronic coughs, and has also been employed in dropsy, rheumatism, and epilepsy.

SYM'PLOCOS is a genus of plants belonging to the order STYRACEÆ. The species are numerous, and are native of the warmer regions of Asia and America. They are trees or shrubs, with simple, usually toothed, leaves and small flowers, arranged in axillary clusters or racemes. The calyx is five-lobed, the corolla five to ten-lobed, the stamens indefinite; the ovary has from two to five cells, and the fruit is fleshy, rounded, and contains one or two seeds. All the species possess an astringent principle in their leaves, and some are used in dyeing. *Symplocos Alstonia*, a native of New Granada, is a branching shrub, 10 or 12 feet high, with shining evergreen leaves, closely resembling those of the tea-plant (*Thea chinensis*). An infusion of the leaves is drunk like tea, and from its astringency possesses valuable medicinal properties. *Symplocos tinctoria* (sweet-leaf or yellow-leaf), a native of Georgia and Carolina, is used for dyeing yellow. *Symplocos racemosa* is a native of Burdwan and Midnapore, in Bengal. The bark is used extensively by the natives as a dye, which is of a brown colour.

SYMPO'SION (Lat. *symposium*) is sometimes translated by "banquet," but it would be more intelligible to most moderns if rendered by "dessert," since it answers somewhat to the custom, still observed at many dinners, of the diners, if gentlemen, "sitting over their wine" to tell stories and converse.

The posture of the diner in Homeric times was a seated one; large joints of meat were brought in and cut asunder by the servants on the board which served for a table. The Cretans retained the sitting posture to a late period, but in the rest of Greece it was limited in historic times to women and youths. To be permitted to recline at meals was to a Greek boy somewhat like earning the spurs in mediæval times, and was often the reward of prowess in the hunting field, &c. It was usual in Greece for two men to recline on one couch, though in Rome the custom was for the couches to be made much larger, so as to serve three. [See Plate TRICLINIUM.] Before the reclining guests, and the seated ladies, if the meal was in the women's room of the house (ladies of respectable position never ate in public), small tables were placed, and these were served with morsels on spits, as knives and forks were not used. Water was brought frequently to cleanse the hands, and a glutinous kind of dough was supplied to wipe the fingers upon. Washing with scented soap was customary at the beginning and the end of the meal. The *deipnon* or dinner took place at sunset, and was the chief meal of the day. In early times as soon as appetite was satiated the guests rose and dispersed; but it came to be felt that to separate so quickly after a banquet was to waste opportunity, and the *symposion* was invented. As its name implies, this was primarily a drinking-bout (Gr. *sun*, together, *posion*, drinking); but it was rarely in any sense an orgie among the temperate Greeks. Rather it was the

"Feast of reason and the of soul,"

than the wine and dessert, which were its attractions.

A general libation to the "good spirit," followed by the clearing of the floor from the crumbs and bones of the *deipnon* and the removal of the tables, marked the close of dinner. Cheese, pastry, salted and spiced cakes, and fruit of various kinds were then served. Wine was not used pure, but mixed with more than its bulk of water, usually one part of wine to 2½ or 3 of water. As soon as all the goblets were filled for the opening libation of the *symposion*, a king of the feast was chosen, by dice or otherwise. He had to see to the due mixing of the wine, to vary and increase gradually the size of the cups (which were always emptied at one draught, with a prayer for the good health of the neighbour to the right hand), and to regulate the frequency of the toasts. His orders were absolute, and offenders were fined rigorously.

The highest form of symposion was such a philosophical conversation as is depicted in the immortal pages of Plato, the guests taking it in turn to illustrate the subject of discourse. (The word is often used somewhat in this sense by moderns, to designate a discussion carried on in the pages of a periodical magazine, &c., by a number of thinkers who contribute essays on the topic under consideration, each one striving to aid or confute the arguments of his predecessor as his own turn arrives.) By far the more usual entertainment was, however, the mixture of intervals of witty converse among displays of amusing performances: as of rope-dancers, conjurers, tumblers, dancers, &c., or among games of chance, dice, chess ("game of cities," in Greek phrase), and the like. Xenophon describes as a symposian entertainment the dangerous sword-dance, where the performer ended by turning somersaults forwards and backwards over the points of three swords stuck in the ground. The Romans sometimes imitated, in their rougher, coarser fashion, the elegant symposia of the Greeks.

SYMP'TOM (Gr. *sumptoma*, an incident or coincidence) is any change in the appearance or functions of the body different from those which occur in health, and perceptible

to the senses either of the patient or his physician. Symptoms must not be confounded with signs of disease. The observation of facts by means of our senses renders us acquainted with symptoms, but it is by medical reasoning thereupon that we deduce signs. Violent pain in the head not unfrequently attends inflammation of the lungs, but is a symptom of very small importance, while slight pain in the side, or a streak of blood in the expectoration, furnishes a very valuable sign, and helps to disclose the nature of the affection. Symptoms are best divided into the *essential*, which are peculiar to certain diseases; the *accidental*, produced by some circumstance of unusual occurrence; and the *common*, which are met with alike in various complaints.

That part of medicine which treats of symptoms is called Symptomatology. Semeiology is the name applied to the investigation of the signs of disease, and of their comparative value.

SYNÆR'ESIS (Gr. *sunairesis*). The contraction of two syllables or two vowels into one, by suppressing one of the syllables, or by the formation of a diphthong, as *ne'er* for *never*, *Atreidès* for *Atreidès*.

SYN'AGOGUE (Gr. *sunagógé*, assembly, place of assembly; Heb. *beth hakkenesath*, house of assembly), a building appropriated to worship and the performance of public religious rites in Jewish congregations. In the New Testament the word is used for the congregation as well as the building, and also in a narrower sense for the court which was connected with or sat in the synagogue. It is is also used in the New Testament as synonymous with *ecclesia*, church, and widely divergent as the two words and the things they represented afterwards became, there can be no doubt that the Christian church had its origin in the synagogue. The institution of the synagogue is placed by some of the Rabbis at a very remote period of the national history, but there is every reason to believe that it was but a development of the modes of worship rendered necessary by the captivity. Removed to a strange land and cut off from their high places and temple, the devout worshippers of Jehovah began to meet in each other's houses for counsel, prayer, and the study of the law. After the return these meetings were continued, special buildings being by degrees erected for them, until nearly every town or village in Palestine had its one or more synagogues, and a similar building was to be found in every foreign city where the Jews formed a colony. At the time of Christ the synagogue and the institutions connected with it played a great part in the life of the nation, and they embraced in their influence both religious and secular affairs. The buildings were usually of stone, square or oblong in shape, in some cases being divided by pillars into aisles. Their size varied with the wealth of their builders or the number of the members, but the Jewish canons required the synagogue to be placed on the most elevated place in the neighbourhood, and to be so constructed as to place the worshippers with their faces towards the temple at Jerusalem. At the upper or Jerusalem end was placed the ark, a chest or cupboard in which the sacred books were kept, and which was veiled by a curtain. This part of the synagogue was the place of honour, and the seats here were allotted to the elders and to persons of wealth or influence in the community. The male Jews occupied the floor of the building, the women sitting in a gallery in the rear, or else one side of the building was allotted to the men and the other to the women, a low partition being placed between them. Between the ark and the congregation was placed an eight-branched lamp for festival occasions, and a little further towards the middle of the building a platform capable of holding several persons was erected, a desk for the reader being placed in the centre. The authorities responsible for the conducting of the worship and maintenance of the synagogue consisted of the elders or rulers, with a chief ruler at their head, who were elected by the congregation after having given proof that they possessed the necessary knowledge. The most prominent functionary in a fully equipped synagogue was the *Sheliach*=legatus, the officiating minister, who read the prayers and took the chief part in conducting the service. He was not a member of any sacred caste or class, however, and any member of the congregation who possessed the necessary gifts might be appointed to the office, or several of them might take it in turn. There was besides a *Chazzan* or minister, who had charge of the sacred books and of the building, and who was generally the schoolmaster of the village or district. At a later period of Jewish history the chazzan became the regular reader of the liturgy. Further, to every synagogue were attached ten *Batlanim*, or "men of leisure," whose duty it was to attend so as to make up the minimum number (ten) necessary to form a congregation when required. The services of the synagogue were held daily, the ordinary services being short, those of Mondays and Thursdays, the usual market days, rather longer, and the principal services being reserved for the sabbaths and national festivals or fasts. On the sabbaths the worship was opened by the recital of two prayers by the reader, to which the congregation responded Amen. Then followed the recitation of the passages from the law, Deut. vi. 4–9; xi. 13–21; Numbers xv. 37–41, which formed the Jewish creed or profession of faith, a long series of collects, technically called "benedictions," to which might be added extempore prayers, and then came the all-important reading of the Law. The roll was carefully taken from the ark by the chazzan, its coverings were removed, and the reader stood up and read from it one verse or division at a time in Hebrew, an interpreter standing by who gave the meaning of the passage in the common speech of the people. After the Law came the Prophets, from which a portion was read and translated three verses at a time, this being followed by an address or sermon, and the sermon closed with a doxology. From this description it will be easy to see how the synagogue worship with its prayers, scripture readings, responses, and sermon, supplied the type on which Christian worship was first based, and moreover the organization of the synagogue was very closely reproduced in the Christian ecclesia.

In addition to the place it occupied in the religion of the Jews, the synagogue by means of its officers exercised also certain judicial powers. Civil cases seem for the most part to have been decided by the local courts of the elders, of which there was one in every town or important village; but offences against religion and morals were brought before a religious court, composed of the officers of the synagogue, the investigation being sometimes held in the meeting-house itself. The penalties inflicted upon offenders included scourging with thirty-nine stripes, a painful but, strange to say, not in Jewish eyes a degrading punishment; excommunication, a penalty involving great social disgrace; and in extreme cases the arrest of the offender and his removal for further trial to Jerusalem. Following the example of the Jews, the Christian church during the first centuries exercised a judicial influence over its members by means of a court of the elders, who sat in judgment upon questions of religion and morals.

Modern Jewish synagogues differ but little from those in the time of Christ, except that instead of "elders" there is now a simple committee elected from the community, without any authority beyond the concerns of the synagogue, and that the offices of reciter, reader, and lecturer are often united in the same person, the chazzan of the synagogue.

So late as the reign of George II. the only synagogues allowed in England were the two in London, one for Portuguese Jews in Bevis Marks, and the other for German Jews in Duke's Place. All restriction has since been re-

moved, and there are numerous synagogues in London, as well as many others in the larger cities of Great Britain.

SYNAGOGUE, THE GREAT. According to Rabbinic tradition, after the return from Babylon, a great council was appointed, consisting of 120 members, derived from the priests, Levites, elders, doctors of the law, and chief Hebrew families, to re-organize the religious life of the people. The president of the council was Ezra the scribe, and its labours included the collection and editing of the sacred Scriptures, the institution of the feast of Purim, the organization of the ritual of the synagogue, and the approving of the eighteen solemn benedictions included in its service. They also defined many of the precepts of the Law, and established schools for the study of it. In the course of time the number of the council was reduced, and on the death of Simon the Just (B.C. 300) it had only seventy members, who became the original Great Sanhedrim. There is so much that is obviously legendary and apocryphal in the Jewish traditions of the Great Synagogue, and the references to it commence at so late a period, that many scholars reject the whole history as a Rabbinic invention. Others, while they reject many of the details, are yet disposed to believe that Ezra gathered round him a number of learned and pious men, to assist in the redaction of the sacred writings and the appointment of religious observances and ceremonies adapted to the altered circumstances of the nation, and that the influence of these men may have continued for a considerable period afterwards, and may have been the origin of some of the institutions of a later date. See Herzog "Real Encyclopædic," xv. 296 *et seq.*, and the article of Dr. Ginsburg in Kitto's "Cyclopædia of Biblical Literature" (third edition, Edinburgh, 1876).

SYNALÆ'PHA (Gr. *sunaloiphê*, from *aleipho*, I anoint), in grammar, the usage by which the final vowel of a word is cut off before the initial vowel of the word immediately following. It is very common in Latin, and frequently used in Italian and Spanish poetry. In French it only applies to the e mute at the end of words. It also occurs in English poetry, as in the following line:—

"Thereby to wipe away th' infamous blot."

The elision of the last letter, especially *m*, in Latin, as in

"Monstr' horrend' inform' ingens, cui lumen ademptum,"

for

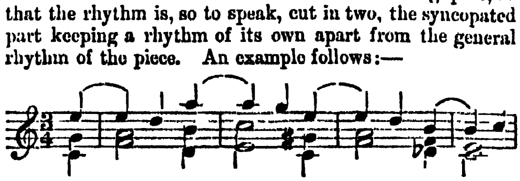
"Monstrum horrendum, informe, ingens, cui lumen ademptum."

is called *ekthlipsis*.

SYN'CHRONISM (Gr. *sun*, with, *chronos*, time), a tabular arrangement of history by which contemporary events in different countries are brought together.

SYNCLI'NAL CURVES. See PLICATION OF STRATA.

SYNCOPA'TION, in music (Gr. *sunkopê*, a cutting in two), is when the first half of a note begins on the unaccented or weak part of a bar, and the other half is continued and terminates on the accented or strong part, so that the rhythm is, so to speak, cut in two, the syncopated part keeping a rhythm of its own apart from the general rhythm of the piece. An example follows:—



SYN'COPE. See FAINTING.

SYN'COPE, in grammar (Gr. *sunkopê*, a cutting off), is a process of cutting down syllables, so that two or more are blended into one. Example: the Old English *hlaford* becomes the modern *lord;* the Old English *hlafdige* (loaf-giver) becomes *lady; laferc* or *laverock* becomes *lark*, &c.

SYN'DIC comes from the Greek *sundikos.* The Greek word originally signified one who aided another in a matter before a court of justice, and hence it came to signify generally an advocate who maintained his client's cause before a court of justice. The word had also other significations at Athens. Syndicus passed into the Latin language. It often occurs in the "Digest" in the sense of an attorney or agent for a *universitas* or corporate body: in this sense it is used as synonymous with *actor* by Gaius. In the middle ages also the word was in common use, and was frequently given to the agent or factor appointed by corporate bodies to manage their common affairs, and especially to represent them in courts of law. The term syndic is also applied, in the University of Cambridge, to members of special committees appointed from the senate for specific duties. The various other significations of the word may be traced in Ducange, Richelet, and other authorities. In the money market a *syndicate* is an association formed for the purpose of carrying out an operation too large to be carried out by one of its members. It differs from a company in being a mere temporary alliance.

SYNEC'DOCHE (Gr. *sunekdochê*, from *sun*, with; *ek* out; and *dechomai*, I receive) is a rhetorical figure by which part is put for the whole, or the whole for the part. There are six varieties or classes: as when (1) a genus is put for a species; (2) a species for a genus; (3) the essential whole for one of its parts; (4) the matter or form for the whole being; (5) the whole for a part; and (6) the part for the whole. In the phrases "Consider the lilies how they grow," "The grass which to-day is in the field, and to-morrow is cast into the oven," the meaning is not of lilies, grass, to-day, and to-morrow; this is a mere synecdoche, which stands for all flowers and their transitoriness, and comes under classes 2 and 6.

SYNE'SIOS, an ancient Christian philosopher of the fourth century, was a native of Cyrene. He studied first in his native city, and then at Alexandria, where he attended the lectures of the famous Hypatia. About the year 397 the citizens of Cyrene sent him on an embassy to Constantinople, to present a crown of gold to the Emperor Arcadius, when he delivered an eloquent address on handing over the gift. Some time after this the Platonic philosopher embraced Christianity and was baptized by Theophilos, patriarch of Alexandria. Such was the esteem in which he was held that the patriarch resolved to ordain him a bishop. But he pleaded his wife, whom he would not put away, his scepticism as to a resurrection, and the nature generally of his studies and speculations. The bishop, however, was inexorable, and Synêsios was in 410 ordained bishop of Ptolemais—retaining his wife, and soon professing his orthodoxy on the points of which he had doubted. He ruled his diocese for about twenty years with exemplary tact and industry—converting also the philosopher Evagrios, and humbling the tyrant Andronikos of Gaza. He seems to have died before 430. The style of his writings is elegant, and they have been universally admired. The best of his Christian works are his "Epistles" (in number 155), his "Homilies," and his ten "Hymns." His more general works are his treatise "On Dreams;" "On Prudence;" "Dion," or "On True Philosophy;" and his "Oration to Arcadius." The *editio princeps* is that of Turnebus (Paris, 1553), which was republished at the same place, with the Latin translation of Petavius (1612). There have been two French translations of his hymns—one by Percheron (Paris, 1581), and another by Gregoire and Collombet (Paris, 1839). A few of them have also been done into English by Hugh Stewart Boyd (London, 1814). Synêsios was more of a philosopher than a divine, and was more at home in Platonism than in theology.

The short Greek medical work on fevers, &c., published under the name of Synêsios, has nothing whatever to do with the old Platonist Christian philosopher. It is a translation from the Arabian philosopher, Abu Ja'far Ahmed, who flourished in the tenth century.

SYNGNATH'IDÆ. See PIPE-FISH.

SYN'OD, a Greek word (literally, a coming together) adopted by the Saxons, sometimes used for an assembly of any kind, but much more commonly for a meeting for ecclesiastical purposes, and more particularly for an assembly of bishops or presbyters deputed by various churches or branches of the universal church to meet at an appointed place, there to deliberate on points of doctrine or other matters relating to the regulation and welfare of the church. [See COUNCIL OF THE CHURCH.] Synods of the English established church can only be held by the authority of the crown. In Scotland, however, a Presbyterian synod may be convened by the general consent of the church, and consists of the ministers and elders of the particular district, in general one elder for each congregation. Should there be a General Assembly at the same time, the synod is subordinate. These synods are also called councils.

SYN'OD OF WHITBY. In the article ST. CUTHBERT this great transaction was spoken of as transferring England again to the dominion of St. Peter. In fact from the first landing of Augustine at Ebbsfleet, in Thanet, down to the Reformation, the power of the Pope never ran so great a risk of extinction in these islands as just before the Synod of Whitby.

The great Irish missionary Columba and the monks of his island monastery of Iona reconverted England after the first Roman missionaries had fled, baffled by the persistent heathendom of our ancestors. From Iona and its branch houses went forth, Chad to Mercia, Aidan and Cuthbert to Northumbria. In Whitby Cædmon sang his divine song. The whole of the north owned allegiance to Iona, and worshipped by the tradition of Columba, instead of looking to Rome and her authority.

Rome saw its danger, and as soon as the immediate danger was past, sent its most zealous priests to regain authority over the independent land. Wilfrith of York, and Benedict Biscop of Wearmouth long stood alone in allegiance to Rome, and long struggled unwearyingly to bring Northumbria to its old obedience. Gradually their exertions raised a small party of followers round them; and these men so eagerly pleaded their cause that the King Oswi summoned the great Synod of Whitby in 664, to quell the strife which was incessantly raging. After some discussion, the main points of difference first to be decided were agreed to be the mode of cutting the tonsure and the time of Easter. Oswi, after hearing the two sides, asked Colman, head of the Irish monks of Lindisfarne (Holy Island), if Christ had given to Columba, equally with Peter, the keys of heaven. On receiving his admission of the negative, Oswi at once pronounced judgment in favour of Rome. Colman and his monks sailed back to Iona, and the independence of the English Catholic Church vanished for just nine centuries. The orderly arrangements of the Roman organization were the reward of submission, however, and perhaps more was gained than lost. Certainly the independent Irish Church afterwards presented a shameful spectacle of quarrel and disorder. The Church of England, after Oswi's decision, was at once taken in hand by Rome, who sent the judicious Theodore of Tarsos as Archbishop of Canterbury to organize the kingdom (668), first, into several sees dependent on the metropolitan, secondly, into parishes dependent on the bishoprics. The king's chaplain became the bishop, and the subkingdom his diocese, the noble's confessor became the parish priest, and the manor his parish. Frequent synods and visitations completed the unity of the work in a marvellously short time.

SYNOD'IC REVOLUTION. The synodic revolution of two bodies which move round a common centre is that portion of one or more actual revolutions in which they go through all their possible relative positions. The simplest instance to which any reference can be made is that of the two hands of a watch—the absolute revolution of the minute hand is made in one hour, that of the hour hand in twelve hours; but the synodic revolution of the two hands is the interval which elapses between any time at which they are together and the next time at which the same thing takes place. Every phenomenon which depends upon the relative position of two revolving bodies, cannot complete all its phases in less than a synodic revolution. Thus, in the case of the sun and moon, the total disappearance of the latter, which takes place when they are nearest in the heavens, cannot take place again until they are again at their nearest; that is, until the moon has not only completed the circuit of the heavens, but has further progressed until she overtakes the sun. Those who would make a common watch tell time in a manner resembling the indications of luni-solar phenomena, must rub out the marks of minutes and hours from the dial-plate, and choose for an interval of measurement that which elapses between successive conjunctions of the minute and hour hands.

The cases of the successive conjunctions or successive oppositions of a superior planet, or successive conjunctions of the same kind of an inferior planet, are examples of synodic revolutions.

Synodic Period of the Moon and Planets.—The moon's synodic revolutions form the most important case, and these, in fact, coincide, as is indicated above, with the moon's lunations. The moon rotates on her axis and revolves round the earth in precisely the same time, namely, 27 days 7 hours 43 minutes; but her synodic period, *i.e.* from new moon to new moon, is longer than this, for the sun has moved forward (speaking the language of appearances) during her revolution, and she has yet some distance to go in the heavens before reaching him and completing her synodic period. The total length of the latter is thus 29 days 12 hours 44 minutes.

The synodic periods of the chief planets are as follows:—

	Mean Solar Days.
Mercury, ...	115·87
Venus, ...	583·92
Mars, ...	779·94
Jupiter, ...	398·87
Saturn, ...	378·09
Uranus, ...	369·66
Neptune, ...	367·49

The times of revolution of the planets (their *periodic times*) are easily found from their synodic periods.

SYN'ONYM. At present the term synonym is applied to different words, which mean, or are supposed to mean, the same thing: as valour, courage; virtue, goodness; vice, wickedness. Though words are often considered to be synonymous, it is probable that very few in the same language really are so. If we compare two languages, we may find synonyms; thus the words for man, horse, dog, &c., taken in any number of languages, may be considered synonymous. Words belonging to the same language may also be synonymous, where the language has received additions from various other languages, among which additions there may be terms which are synonymous (in the modern sense) with native terms of the language into which they are introduced. For instance, in English there may be native English terms which are, or rather once were, synonymous with other terms which have been introduced into English immediately from Latin, or through the medium of Italian and French. It is said "once were," because though such words may have been synonymous originally, and introduced by writers for the sake of variety or harmony, or to avoid repetition of the same word, it rarely happens that they continue to have their original meaning.

A fruitful source of synonyms is the adoption of the same word from two sources; for instance, from the French (which derived it from the Latin), or from the Latin direct. Thus

we have *coy* (Fr.) and *quiet* from Latin *quietus*; *frail* (Fr.) and *fragile* from Latin *fragilis*; *sure* (Fr.) and *secure* from Latin *securus*; *penance* (Fr.) and *penitence* from Latin *pœnitentia*, &c. But the meaning of many of these pairs differs most widely at the present day; see, for instance, ray and radius, treason and tradition, forge and fabric, orison and oration, sir and senior, poor and pauper, &c. A few Greek pairs also occur; as blame and blaspheme, phantom and phantasm, fancy and fantasy, story and history. And therefore while we have a "Histoire de France," we have a "Storia d'Italia."

These are synonyms by common origin, whose present meanings vary; but the true synonyms, whose present meaning is identical or nearly so, are usually distinct words, the Latin or French word on the one hand balancing the native English on the other. After the Norman Conquest for a long time there were two tongues spoken in our island, and necessarily for every idea there were two words. The result is a great richness of vocabulary. It is sometimes gravely asserted that this is the true cause of the absurdly pleonastic verbiage of lawyers, especially conveyancers, when drawing up formal documents. The following are a few examples:—benediction and blessing, commence and begin, flour and meal, gain and win, desire and wish, gentle and mild, terror and dread, labour and work, &c. The trick of the orator merely repeating the same phrase in other words, while appearing to give a new statement of the point at issue, is therefore easy of accomplishment in English.

Synonyms form an important object of philological study, and demand, on the part of the inquirer, great knowledge of the principles of language.

SYNOP'TIC (Gr. *sunoptikos*, visible at a glance), in Biblical criticism, is the term generally employed to distinguish the first three Gospels, which contain a corresponding succession of events and parables, from that of St. John, whose narrative and discourses are almost entirely independent.

SYNO'VIA (Gr. *sun*, with, and *ôon*, an egg), or *Joint-oil*, is the name applied to the albuminous fluid by which the joints of the bodies of animals are lubricated. It is separated from the blood which circulates in the vessels immediately surrounding the joint. Its quantity is in direct proportion to the size of the joint, and is always sufficient to keep the articular surfaces smooth and slippery, and to fill up those recesses into which the adjacent soft tissues do not exactly fit. It is chiefly composed of water, in which are held in solution mucus, albumen, fat, and salts, with a little extractives.

Synovial membranes are those which line the cavities of joints, that is, the small space which separates the bones forming the articulation. In the construction of its tissue, a synovial membrane is practically identical with a serous membrane, and it also resembles it in being always a closed bag with an attached and a free surface, the latter being moist. One form of synovial membrane, the *bursa* (purse), has for its function to facilitate the gliding of a tendon over a bone, &c. Such sacs, containing synovia, often throw out sheaths (synovial sheaths) to surround long tendons, *e.g.* the great flexors and extensors of the fingers and toes. It is the inflammation of one of these sheaths which is the danger of deep whitlows, and may result in adhesions which destroy the motional power of the inclosed tendon, and permanently stiffen the joint.

SYN'TAX (Gr. *sun*, together, *taxis*, arrangement), is the construction of sentences, the due arrangement of words and sentences, according to established usage. It includes concord and regimen, or the agreement and government of words. Words in every language have certain relations, as verbs and adjectives, with nouns, which relations must be observed in the formation of sentences. Analysis is another large division of syntax.

SYN'THESIS (Gr. *sun*, and *thesis*, putting together). Synthesis teaches by construction; analysis by the undoing, as it were, of the parts of a previous construction. If the construction of a watch were actually shown, and its capability to fulfil the object of the maker inferred from the consideration of the necessary connection of the parts (not merely proved by experiment from the going), this would be a synthetical explanation. But if, the actual performance of the machine having been first contemplated, its structure were then to be examined, by pulling it gradually to pieces, and properly inferring the effect of each removal, this would be an analytical examination.

Pure analysis or pure synthesis rarely exists in large quantities in an unmixed state in any science whatsoever.

In the exact sciences there is something like analysis, but much intermingled with synthetical processes. M. Charles says there is hardly such a thing as analysis, properly so called, in mathematics; and in the strict sense, one should agree with him, and add further that, except for learners, there is as little of pure synthesis. Generalization and abstraction, the application of that which has been found ineffective in the species to all other cases of the genus, and the separation of that which appears at first peculiar, but on further examination turns out to be only peculiar because a mode of thought capable of wide application has been incidentally mixed up with those which *are* essential to the problem in question, are two of the most powerful instruments of mathematics. But to which do these belong? to synthesis or to analysis? If every separation of ideas be analysis, the latter process may have that name; if every further application of that which has once succeeded be synthesis, the former may be also. But the strict use of these terms would not allow of either extension; and if we be right in saying this, it unquestionably follows that pure analysis and synthesis, far from being the only instruments of the exact sciences, are not even the most prominent ones.

Under the general notion that all inquiry which proceeds in a reverse order is analysis, and that all which may be dignified by that name is sound mathematical reasoning, much fallacy has been introduced into the elements of mathematics, the effects of which are only beginning to disappear. The process is as follows:—Assume a problem to be solved; proceed to separate the known from the unknown, or in any manner to make that which is unknown capable of being compared with the known; the result when obtained is the solution of the problem; such is the language held. But it was forgotten that the assumption of the possibility of solving the problem *was an assumption*; and that the conclusion should have been, not "This is the solution of the problem," but "If the problem have a solution, it must be this." To illustrate the faulty method by an example: suppose a beginner in algebra, with a competent knowledge of arithmetic, and without any absurd pre-definition of negative quantities, has the following question proposed:—"Given $3x-11=5x-15$; required the value of x." He is told to proceed thus:—

$$
\begin{array}{rl}
\text{Let} & 3x-11=5x-15 \\
\text{Add } 15-3x \text{ to both sides,} & 15-11=5x-3x \\
\text{or} & 4=2x \\
\text{or} & 2=x \\
\text{Therefore} & x=2 \text{ is the value required.}
\end{array}
$$

Now the fact is, that the equation proposed is impossible to such a student: all that is proved is that *if* there be a solution, it is $x=2$; but when he is told to try whether $x=2$ is a solution, he finds $3\times 2-11$ an operation which cannot be performed at the first step.

As these blots are gradually removed, so does the surface of the higher mathematics become more and more synthetical in all the elementary parts.

In the meanwhile there is a view of the higher mathe-

matics which will render the common term *analysis*, as applied to them, appropriate enough. The further we proceed the greater is the power of taking out the reverse process, in which analysis was defined to consist, from the domain of the hypothetical syllogism, and placing it in that of rigorous deduction; the consequent increase of the power of pure analysis, or at least of that proceeding which most resembles it, may suggest the application of the term as descriptive at least of the ultimate tendency of all progress, though not of a result as yet entirely obtained.

SYN'THESIS, in chemistry, is the process of forming a compound by the union of its elements. It is the putting together, as opposed to the pulling to pieces, of analysis. The science of chemistry was long spoken of as being only available for the latter process, especially in organic chemistry, where so many of the compounds have been formed by nature and have hitherto defied the imitation of science. Such, for instance, is the very important alkaloid quinine, which has not yet been produced in the laboratory; but recent years have enriched the labours of synthesis by many new products, and added largely to those of natural origin produced artificially. Artificial indigo and alizarin have already become important chemical industries, and there are indications that quinine, morphine, and strychnine will not much longer compel chemists to go to natural sources for their production. Berthelot, in 1856, first showed that the organic compound potassium formate can be made by the direct union of carbonic oxide and potassium hydrate, both inorganic materials, and that acetylene, marsh gas, and ethylene can all be made directly or indirectly from the combination of carbon and hydrogen, and from these the alcohols, ethers, and aldehydes can in turn be produced. In this way he obtained a most extensive series of organic bodies from purely inorganic constituents, and laid the foundation of the synthesis of complex organic bodies.

SYN'TONIN (Gr. *sunteinein*, to render tense), also called *Muscle Fibrin*, is the principal constituent of all contractile tissues, and is supposed to be held in the living animal body in the form of a solution. It is procured from muscular fibrin in a coherent and elastic substance of a very white colour; and contains carbon, 56·06 parts; oxygen, 21·50; nitrogen, 16·05; hydrogen, 7·28; and sulphur, 1·11. Another name for syntonin is "acid-albumen;" for any proteid or fibrin acted on by strong acids or by gastric juice will yield it, and all these acid-albumens are indistinguishable from syntonin, prepared in the most usual way by treating finely chopped muscle with dilute hydrochloric acid after having washed away all the soluble albumens. The syntonin prepared from muscle is precisely the same as that prepared from white of egg or from serum-albumen. In any form it is a white, opaque, gelatinous mass, soluble in very dilute acid or alkaline solutions, but insoluble in solution of sodium chloride.

SY'PHON, an incorrect but frequent form of spelling Siphon. See HYDRAULICS.

SY'RA or **SYROS,** at present known as *Siro*, is an island of the Grecian Archipelago, belonging to the group anciently called the Cyclades. It is about 11 miles long and 5 broad, has an area of 55 square miles, and is intersected by hills and narrow valleys. Homer and other Greek poets describe Syra as rich in pastures, wine, and corn; but it is now far from naturally fertile, and although well cultivated, does not produce sufficient food for the consumption of the inhabitants. The chief products are wine, corn, silk, honey, figs, and vegetables. The harbour of Syra, or *Hermopolis*, on the eastern coast, is convenient, safe, and deep, protected by a lighthouse with a revolving light, and has a very considerable trade, nearly half of the imports into Greece passing through it. The town is built terrace-like from the shore, around a conical-shaped hill. In 1887 the population was over 20,000 (that of the whole island being about 30,000), while it was only 4500 in 1825. Syra is now the residence of consuls of most European states, and is a principal station of the Mediterranean steamers going to and from Constantinople. It has a large ship-building trade, and owns more than half the merchantmen belonging to Greece. On the west coast, near Maria della Grazia, are the ruins of an ancient town, and the island contains many other valuable relics of antiquity. The philosopher Pherekudês was a native of Syros; he flourished about B.C. 544, and was always held to be the instructor of Pythagoras in the Phœnician and Egyptian mysteries.

SYR'ACUSE (Gr. *Surakousai;* Ital. *Siracusa*), a town finely situated on the east coast of Sicily, 30 miles S.S.E. from Catania, and about the same distance N. by E. from Capo Passaro, the southern extremity of the island. Ancient Syracuse, in the time of its splendour, was the largest city in Sicily, and one of the largest in the world. It was of a triangular form, and consisted of five towns, adjoining each other, but separated by walls: the oldest of these was Ortygia on the peninsula, originally an island of an oblong shape, about 2 miles in circumference, lying between the Great Harbour on the west, which is a splendid piece of water about 5 miles in circumference, and the Little Harbour, which was paved with marble flags, on the east. On the other side of the Little Harbour was the town of Achradina, which extended for about 3 miles to the eastward along the sea-coast, until it reached a bay, where was the port of Trogilos, outside of the city. The western part of Achradina, adjoining Ortygia, stood on low ground, on a level with the island; but the remaining and larger portion of it lay on a range of heights which stretch from the sea for several miles inland, and are divided from the lowland by a natural wall of rocks. North of Achradina, and inland, stood the town of Tychê, on the same range of heights as the upper part of Achradina, being divided from the latter only by a double wall and a road between. Tychê extended inland to the northward for a length of above 2 miles, and at its western extremity was the Epipolai, consisting of several commanding heights, which were inclosed and made into a vast fortress by Dionysius the Elder. South-west of Tychê, in the lower ground at the foot of the heights, was Neapolis or the New Town, which, at its southern end, adjoined the lower part of Achradina. The whole was surrounded by an external wall, the length of which was 180 stadia, or rather more than 22 miles. Ortygia was the first part inhabited; but the population increasing, the island was joined to the mainland by a causeway across the narrow channel of the sea, and the neighbouring low grounds were built upon. The population still continuing to increase, the heights were occupied, and Achradina became a large and handsome town. Tychê was next built, and lastly Neapolis or New City. After the Roman conquest the inhabitants gradually decreased, and at last became restricted to the original Ortygia and the lower part of Achradina. All the upper city was abandoned in the time of Augustus. The Saracens in the ninth century plundered and devastated Syracuse, which contained till then about 100,000 inhabitants, and from that time Ortygia, or the island, has been the only part inhabited.

The greater part of the upper town of Achradina, especially near the sea, is now a naked dreary rock, the surface having been thoroughly cleared of the materials of the ancient city. The sea has undermined the shore, and the town walls have fallen in and disappeared. Considerable remains of the external wall built by Dionysius the Elder, are seen further north round Tychê and the Epipolai, beginning from Scala Græca near the port of Trogilos, and following without interruption the sinuosities of the hill.

The remains of ancient Syracuse itself are inconsiderable. Of the theatre, which was hewn out of the rock, nothing whatever is left. Not far from where the theatre stood

lie the remains of an amphitheatre of the Roman period. The catacombs are vast excavations of remote antiquity, which have been used for burying the dead. The aqueduct which supplied the ancient city with water was begun by Gelôn, who was ruler of Syracuse at the time of the Persian invasion of Greece under Xerxes, B.C. 480. Outside of the walls, and on the left bank of the Anapus near the Great Harbour, are parts of the shafts of two fluted columns of the temple of Zeus Olympios.

The modern town of Syracuse is a bishop's see, has 20,000 inhabitants, narrow and dirty streets, numerous churches and convents, and other public buildings, the most remarkable of which is the cathedral, once the temple of Athêna, which was plundered of its ornaments by Verres. This fine Doric edifice was renowned for the splendour of its decorations, and it has been a place of worship continuously for 2500 years. Its exterior dimensions are 185 feet in length and 75 in width. It has been repeatedly repaired, and a new façade erected in very bad taste. There are also some remains of the temple of Artemis near St. Paul's Church. The Church of St. Marcian claims to have been the first in Europe for Christian worship. The celebrated fountain of Arethusa is a large pool of water, supplied from a spring, and separated from the sea by a wall, near the Great Harbour; and about 80 yards from it rises from the bottom of the harbour another copious spring, called l'Occhio della Zilica.

There is a museum at Syracuse containing the statues of the Landolina Venus and Æsculapius, some sarcophagi, a handsome collection of vases, inscriptions, coins, &c., discovered in the town and neighbourhood, and a public library.

Syracuse enjoys a delightful climate in winter, but the alluvial plain on the west side of the harbour, through which the Anapus flows, exhales pestilential miasma in the summer months. The surrounding country is very fertile. On the left bank of the river is the fountain of Cyane, now called the Pisma: it is a circular basin of the purest water, about 60 or 70 feet in diameter and 26 feet deep, stocked with fine fish. From it the water flows in a quiet deep stream to the Anapus, on the sides of which is found the *Cyperus papyrus* floating in abundance.

Many of the women of Syracuse, especially of the lower orders, are remarkable for the Grecian contour of their features. The people carry on some little trade by sea with Malta, chiefly in oil, wine, salt, and salt fish, but the place is by no means thriving.

History of Syracuse.—About 735 B.C., one year after the foundation of Naxos by a colony of Chalkidians, Archias, a Corinthian, the head of a colony of Corinthians and Dorians, settled in the small island of Ortygia, having overpowered the native Siculi. This settlement, which afterwards extended to the mainland of Sicily, was the origin of the great city of Syracuse. The Greek name of this famous city, like Athens, Thebes, and so many other Greek examples, is in the feminine plural, *Surakousai*, and is derived from the neighbouring marsh, *surakô* in the native dialect. In the case of Syracuse the plural form is easily explained, for it was not so much one city as five, and these quite distinct in many respects. They were Ortygia (Gr. *Ortugia*), also called "the island;" Achradina, the upper city. Those two formed Syracuse at the time of the famous siege. The other suburbs only grew important later on; they were Tuchê (Fortune), Epipolai (Heights), and Neapolis (New City). The epochs of the foundation of the four suburbs on the mainland are not known. Syracuse herself sent colonies to other parts of Sicily, which founded Acræ, Casmena, and Camarina.

The internal history of Syracuse at first is very obscure. The power was in the hands of the Geomoroi, the original colonists who had taken possession of the land. Their estates were cultivated by slaves or serfs, who were the native Siculi reduced to bondage at the conquest. Fresh colonists coming in from other places formed the Demos, or popular body, which, like the early Roman plebs, was excluded from the body politic. The demos, however, having increased in numbers and wealth, claimed to participate in the offices and honours of the state, and about 492 B.C., being joined by the serfs, they effected a revolution and expelled the patrician aristocracy. The democratic government that followed was one of confusion, and did not last long; for Gelôn, tyrant of Gela, having taken the part of the exiled geomoroi, marched to Syracuse with an army, and the people willingly opened the gates to him, when he was acknowledged as tyrant (*turannos*), or sovereign, of Syracuse, 485 B.C. The rule of Gelôn was temperate, and his reign was prosperous for Syracuse. [See GELON.] He was succeeded by his brother Hierôn [see HIERON I.], who was followed by his brother Thrasuboulos, B.C. 467, but the latter proved so tyrannical that he was driven out after one year's reign. Syracuse being now freed from her despotic rulers, a new constitution was formed; but the city was disturbed by factions, and many of the more distinguished citizens withdrew from public life, leaving all power in the hands of the poorer classes.

In B.C. 416 a quarrel between the towns of Egesta and Selinos brought in the Syracusans, who took the part of Selinos. The people of Egesta applied for aid to Athens, which sent to Sicily a formidable expedition, B.C. 415. It proved, however, a total failure, owing to the assistance of Sparta, which espoused the cause of Syracuse. A very fine raised model, giving a topographical outline of Syracuse, all the ancient features still remaining unaltered, was prepared on a scale of about 3 inches to a mile, by Professor Haverfield of Lancing College, in 1887, and issued at a moderate price, with the express view of adding actuality to the immortal description of this siege in Thucydidês. Of 40,000 men who were engaged in it, nearly all were killed or taken prisoners, and not a single vessel returned.

After the defeat of the Athenians Dioklês proposed in the assembly of the citizens, that as all had shared in the common danger and defence, all should share alike the offices of the state; and, moreover, that public offices should be filled, not by election, but by lot, a measure which was adopted. Diokles at the same time compiled a criminal code of a very severe kind. This democratic condition lasted very few years, for in 406 B.C. Dionysios (Gr. *Dionusios*), a clever demagogue, was elected commander, and soon became tyrant of Syracuse. The great city had now all its five parts included in a common fortification 22 miles round, the population being over 500,000. The events of his long reign, including his wars against Carthage, are narrated under DIONYSIUS THE ELDER. He was succeeded by his son, who was finally expelled by Timoleôn. [See DIONYSIUS THE YOUNGER.] Timoleôn established a government of mixed democracy and aristocracy. After his death B.C. 337, there was a period of twenty years marked by no very important events, till B.C. 317, when Agathoklês, by violence and treachery, usurped the supreme power in Syracuse.

This adventurer is said to have been the son of a potter and to have worked at his father's trade. His first step in life was marrying a rich widow. Though he had obtained the supreme control of affairs he did not assume the state or title of king, but contented himself with the reality. He aimed at the dominion of the whole of Sicily, and succeeded in reducing all the people of the island, except the Carthaginian colonists, subjects of Carthage. His wars with the Carthaginians, and his struggles to maintain his power, in which he scrupled at no act of villainy, occupied all his time. He did nothing, so far as is recorded, for the permanent prosperity of his country. He died, B.C. 289,

at the age of seventy-two, after holding his power for twenty-eight years.

Syracuse now recovered its independence, but being distracted by factions, the people chose, in 275, for their prætor, Hierôn, who was a descendant of King Gelôn, and five years later they elected him king. His very long and upon the whole happy reign is narrated under HIERÔN II. He died B.C. 216. His grandson, HIERONYMOS, did not inherit his abilities; he quarrelled with Rome, which Hieron had managed always to keep friendly with, and which had become the preponderating power in Sicily. Although he was murdered shortly after, his policy was persevered in, and a Roman army, under Marcellus, laid siege to Syracuse, and took it in 212 B.C. The siege lasted two years, and is for ever memorable on account of the ingenuity with which the great geometrician Archimêdês invented new devices of defence. Here ended the history of the city as a state. From that time it was merely a town of the Roman province of Sicily.

In mediæval times Syracuse sustained a lengthened siege, and was eventually captured and partially destroyed by the Saracens in 878. It was very much injured by an earthquake in 1693. Syracuse was the residence at different periods of Plato, Simonides, Zeno, and Cicero; the place where Hiketas is said to have first propounded the true revolution of the earth; and the birthplace of the poets Theokritos and Moschos, and the philosopher Archimêdês, who lost his life at the capture of the city by the Romans.

SYR'ACUSE, a town of the United States, in the state of New York, situated at the south end of Onondago Lake, 131 miles west by north from Albany, at the junction of the Oswego and Erie canals. It is the chief place in the United States for the production of fine salt from highly productive salt springs in the neighbourhood. There are also large steel and iron works, and some fine buildings in the town, including numerous churches, a city hall, county court house, university, opera house, and several banks. The population in 1880 was 51,791.

SYREN, SYRENS. See SIREN, SIRENS.

SYR'IA is the European name of a country in Asia Minor, which is situated along the eastern shores of the Mediterranean, and is a province of the Turkish Empire, which formerly included the LEBANON, placed under a special governor in 1861, and PALESTINE, since 1873 placed in direct relations with the central government in Constantinople. Syria, so limited, has an area vaguely estimated at 108,000 square miles, with a population of about 1,000,000. The name by which it is known to the Asiatics is that of Belad el Sham, abbreviated into 'E'sham, or "the country to the left." The Mohammedans of Mecca direct their face to the rising sun when they pray, and then Syria is on their left, and Belad el Yemen or Yamen (to the right) on the other hand. The Turks call the country Soristan.

The boundary is well marked towards the north, where it is formed by that portion of the range of Mount Taurus which is at present known by the name of Alma Dagh (the ancient Amanus), and on the west, where it is washed by the Mediterranean Sea. Towards the south and east, however, the boundaries are ill-defined, for there the country is contiguous to deserts inhabited by nomadic tribes, who sometimes acknowledge the authority of the Turkish sultan, but more frequently disregard his orders and those of his governors. The situation of Syria is peculiar. It is an isthmus which lies between a sea of water and another of sand; for on the west lies the Mediterranean, while on the east a sandy desert extends to the Persian Gulf.

The west or coast portion of Syria is mountainous, while the more inland part is mostly flat. The mountains run north to south parallel to the Mediterranean. The principal chain is known in different parts of its course as Alma Dagh, Jebel-Anzeyry, and Libanus or Lebanon: it runs at an average distance of about 24 miles from the sea, from the range of Taurus in the extreme north, as far south as the vicinity of Tyre, where it terminates. The chain of Anti-Libanus detaches itself from the foregoing in about 34° lat., and running south parallel to, and at no great distance from it, incloses the famous valley called Cœle-Syria, or Hollow Syria, which is very fertile. It is, in fact, the most valuable tract in the whole country; it extends for 230 miles in length, and has a width varying from 6 or 8 to 15 or 20 miles. Near where Libanus terminates, Anti-Libanus divides into two chains, inclosing the valley of the Jordan, the Dead Sea, &c. [See the article PALESTINE, which contains much interesting information relating to that part of Syria.] Both Libanus and Anti-Libanus give out numerous lateral spurs, some of them extending so as to project, like Mount Carmel, in bold headlands on the coast. The mountains of Anti-Libanus, which surround the Dead Sea, and those to the west of the Jordan, are arid and stony, full of precipices and caverns, and wear a melancholy, desolate appearance, harmonizing well with that of the desert, by which they are bounded on the east. The highest point is Jebel-el-Sheik, the ancient Hermon, "Old Man's Mountain," about 30 miles west of Damascus, which has an elevation of about 10,000 feet. It is visible from almost all parts of Syria, and forms an important landmark for the guidance of caravans. The highest point of the Libanus mountains, Dahrel-Khotib, in that part of the range called Jebel Makmel, is also about 10,000 feet above the sea-level, and is covered with snow all the year round. On both sides of this range a terrace occurs somewhat about the middle of its height, which divides it into the Upper and Lower Libanus; the former is a lofty region, with few trees; but the latter is one of the most interesting parts of Asia. It is a continuous series of hills and deep valleys, which present a great variety of productions, including the vine, olives, figs, and mulberries, while some remnants still exist of the forests of pine, oak, and cedar—the latter often mentioned in Scripture—which were formerly so abundant here. See LEBANON.

The western part of Syria, consisting of a narrow belt of lowland extending between the sea and the mountains, is in some places sandy, but generally fertile; the eastern consists for the most part of a bare, arid, sandy plateau, occasionally relieved by a few oases. It produces scarcely anything but some spare bushes of wormwood, and the usual aromatic plants of the wilderness. The region is traversed with difficulty, but much has been done by means of the Palestine Exploration Fund to survey and examine these regions. The most remarkable oasis is at Palmyra, where there are several small streams, and palm trees abound.

The principal rivers are the Euphrates, confined to a part of the north-eastern frontier; and the Jordan or Ghor, which, rising on the north of Jebel-el-Sheik, continues its course almost due south through the valley of El Ghur, remarkable, particularly in its south part, for its great depth below the level of the sea. In the course of the Jordan are the lakes of Merom and Tiberias, the latter celebrated as the scene of some of our Saviour's miracles; and at its mouth is the far larger lake of the Dead Sea. The mountains which traverse the west of Syria from north to south are broken through in three places: in the north by the lower Orontes, in the centre near Tripolis, and further south by the Leontes. The coast-line in this part of Syria is also watered by several small streams, which contribute greatly to the fertilization of the land, but none of them are navigable.

The surface of Syria being very uneven, the climate and products vary greatly within short distances. The Arabs say, with truth, that the mountains of Lebanon "bear winter on their heads, spring on their shoulders, and autumn

in their bosom, while summer lies sleeping at their feet." Along the coasts the heat is great, and the vine, orange, banana, and date flourish, while at the same time the highest summits are seen covered with snow. In the north, and on the elevated plain east of the mountains, the climate is colder; but at Aleppo frosts are seldom severe, and snow rarely lies on the ground for more than a day at a time. The corn is nearly ripe early in May; and from June to September summer heats prevail, unrelieved by any rain; and though in the west the sea breezes have a slightly cooling effect, in other parts of the country it is so exceedingly dry and hot, as to differ little from Arabia. The *samiel*, a wind like the *simoom* of the desert, sometimes occurs at this season, and shocks of earthquake are frequent. Heavy rains fall in spring and autumn, and the trees frequently retain their foliage till the beginning of December. Syria comprises a large extent of very productive soil. Wheat, barley, maize, millet, lentils, and sesamum are raised in the plains near the rivers. Cotton and the mulberry flourish on the coast, and silk is produced on the slopes of Lebanon. The other chief products are tobacco (that of Latakia is in very great repute), sheep's wool, olive oil, sugar, indigo, scammony, and other gums, safflower, dates, timber, hides, and skins. The domestic animals are camels, oxen, goats, sheep, mules, asses, and horses, and they still, as in antiquity, form a chief part of the wealth of the inhabitants. Game is plentiful; and the bees yield honey in abundance, and of such excellent quality as to form an important branch of rural economy. The chief wild animals are gazelles, hyenas, jackals, bears, wild boars, and buffaloes.

There are no metals found in Syria except iron, which is worked in the Kesrouan in Mar Hanna, west of Beyrût, where also coal has been discovered. In the Tyh Beni Israël, and at the southern extremity of the Dead Sea, are mountains almost entirely composed of rock salt. Bitumen is collected on the western shores of the Dead Sea. In the northern Ghaur pieces of native sulphur are found at a small depth beneath the surface. In the country surrounding the Dead Sea many traces of volcanic action may be observed. Hot springs occur in numerous places, and in others depressions exist which have the appearance of craters.

Although but few of the manufactures for which Syria was anciently renowned survive at present, it is still more important in this respect than any other country in Western Asia. With the exception of hardware, cutlery, and cotton goods, there are few manufactured articles imported; but a great variety of goods which are made in Syria are exported to Egypt and Anatolia, and still greater quantities are sent to the countries further east, and find their way into Persia, where they meet the articles brought from Hindustan. The chief manufacturing town is DAMASCUS. The Phœnicians were probably supplied from this place with a great number of articles for the market of the countries that surround the Mediterranean, and in return they supplied the manufacturers with some of the materials used by them. The chief articles now made at Damascus are silk stuffs, especially satin and silk damasks, which take their name from the town, and brocades. Caravans frequently go from Damascus to Haleb (Aleppo) taking no other goods but articles of this description. There are also silk manufactures at Aleppo and Beyrût, and cotton and woollen fabrics, gold and silver thread, glass, earthenware, leather, soap, &c., are made in different parts of the country. The towns, except the above, supply, however, only the neighbourhood and the Bedouins who resort to them, rarely, if ever, working for a distant market.

The commerce between Syria and the countries to the east and north of it is very extensive, and is concentrated at Aleppo, and a much-frequented caravan route runs from Alexandretta, its natural port, through it eastwards to the Euphrates at Bir, here ramifying westwards to Diarbekr and Kurdistan, southwards to Bagdad. From Aleppo the great caravan and pilgrims' route to Medina and Mecca follows the Orontes valley by Hamah and Homs to Damascus, running thence through the Hauran southwards to the Arabian peninsula. Damascus itself is connected with the coast at Beyrût by a splendid specimen of French engineering, which is carried right over the Anti-Lebanon and Lebanon, and across the Bekáa and the plains of Phœnicia, for a total distance of 65 miles. Another well-known route runs from Damascus across the Upper Jordan valley and through Nablus south-westwards to the coast at Jaffa, where it converges on the main road from the coast to Jerusalem. But the highways are not kept in good repair, and most of the other routes across the country are mere caravan tracks or bridle paths. Telegraphic communication has also been established between Syria and Constantinople and Cairo. The chief European trade is with Great Britain, consisting mostly of cotton, woollen, copper, and iron manufactures. The exports chiefly consist of gall-nuts, seeds, and tobacco. The coast of Syria presents almost a straight line, extending through nearly six degrees of latitude, and is but little indented by arms or inlets of the sea. The principal are the bays of Scanderoon and Antioch. Though it was in antiquity the seat of a great maritime people, it has very few good harbours: the best are those of Scanderoon and Acre. The former, however, is inconveniently situated at the northern extremity of the country, and is, besides, very unhealthy. The harbours of Tyre and Sidon, once so famous, are now, for the most part, filled with sand, or otherwise choked up.

Inhabitants.—The population of Syria consists of agricultural and nomadic tribes. Nearly all the Fellahs, as the agricultural portion of the population is called, belong to one race, resembling in the structure of their body the Bedouin Arabs, and speaking also the Arabic language. They are divided, however, according to their religion, into Christians, Jews, and Turks. Under the last name all the Mohammedans are comprehended. The MARONITES, who have joined the Roman Catholic Church, constitute a peculiar sect. There are also a large number of adherents to the Greek Church, and three religious sects, which are neither Christians nor Mohammedans—the Druses, the Anzeyries or Nossaïries, and the Ismaulies. The most powerful of the latter are the DRUSES. The Anzeyries, or Nossairies, inhabit the mountain region which has received its name from them, and which lies between the lower course of the Aazy and the Mediterranean. They are an industrious people. The Ismaulies are few in number, and inhabit some villages in the mountains of the Anzeyry. They are considered to be a remnant of the Assassins and Ismaelites. See ASSASSINS; ISMAELITES.

There is hardly any tract of considerable extent in Syria without nomadic people on it. This is the effect of the character of the country, in which two districts are generally found contiguous to each other, one of which affords pasture in winter and is barren in summer, while the other yields grass in summer, and cannot be pastured with advantage in winter. This obliges those who have large herds or flocks to have recourse to a continual change of abode; but such a system is ruinous to agriculture. There appears to be at present only one tribe of Bedouins in Syria who never cultivate the ground, but who live exclusively on the produce of their herds of camels, sheep, and goats. This is the Aeneze, who wander about in the Syrian and Arabian deserts, from 28° to 36° N. lat. in winter, but pass the summer within the limits of Syria. The other Arabian tribes are to some extent agricultural.

The Turkomans and the Kurds are in almost exclusive possession of the elevated range of the Alma Dagh and the tracts at its base. The eastern districts of these mountains are occupied by the Kurds, and the western by the Turko-

mans. The latter belong to the great Turkish race of Central Asia; while the former are evidently a tribe who emigrated from the table-land of Kurdistan. The Turkomans carry on many branches of manufacture; but the Kurds are mostly shepherds and agriculturists.

History.—The early annals of Syria, like those of Egypt, are involved in the mists of legend and fable; but we know that even in the remote days of Abraham Damascus was a city:—

> "Match me this marvel save in Eastern clime,
> A rose-red city, half as old as time;"

that at the time of its conquest by the Jews it was crowded with flourishing towns; and that between its king, Hiram, and the Jewish sovereign, David, a cordial alliance subsisted. Both to David and Solomon the Syrian princes, of whom there were probably several, and all independent of each other, paid a yearly tribute; but after Solomon's death they appear to have thrown off the Jewish yoke. About B.C. 980, Rezin, a slave, made himself master of Damascus, and afterwards united the scattered states of Syria in one powerful kingdom. He was succeeded by several kings, one of whom, Benhadad, made war upon the Jews; but the monarchy fell before the invasion of Tiglath-Pileser, king of Assyria, in B.C. 740, when Syria became an integral part of the vast Assyrian Empire. In 537 it was conquered by Cyrus, the Persian hero, and remained Persian until its conquest two centuries later (333) by Alexander the Great.

At the death of the great Macedonian conqueror and the disruption of his empire by his generals, Syria fell to the share of Antigonos, from whom it was soon wrested by Seleukos, who founded the powerful kingdom of Syria (B.C. 312), and the celebrated dynasty of the Seleukids (Gr. Seleukidai, Lat. Seleucidæ). Seleukos was assassinated by Ptolemy Keraunos, B.C. 280. Under his son and successor, Antiochos I., Sôtêr, Hellenic civilization was diffused throughout the kingdom, and the important cities of Seleukeia, Antioch, which became the capital, Apamêa, and Stratonikeia were established, and colonized by Greeks. The dynasty of the Seleukids reigned for 250 years [see SELEUKOS]; but their vast dominions gradually dwindled down to the narrow territory of Syria alone, while their history became a dreary record of internal crimes and hostile invasions, of murderous contests within and constant encroachments from without, until Antiochos X. was dethroned by Pompey (B.C. 65), and Syria converted into a Roman province (B.C. 63).

For upwards of two centuries Syria rested peacefully under the shadow of the Roman Empire; but as Rome grew weak this fertile and genial province excited the cupidity of the Persian kings of the later Persian monarchy, who annexed it. It was subject to the Sassanids for several years, but again recovered from them, and Rome maintained her hold u· n it, though with ever-increasing difficulty. At one tim the power of the Syrian free city of "the Palm Tr es," Palmyra, a city founded originally by Solomon under the name of Tadmar (of which Palmyra is but a translation), rose under Zenobia in the third century to such a height as to render its suppression a task calling forth all the powers of Rome. The Emperor Aurelian took it, however, in 270, plundered it, and led away its heroic queen to captivity. The irruptions of the Saracens tore Syria from the weak hands of the later emperors, and Christianity was replaced by Mohammedanism in 638.

In 654 Damascus again became the capital of Syria, and in 661 of the great Mohammedan Empire. The capital was removed to Kufa in 750, and afterwards to Bagdad, and Syria thenceforth became only a province of the empire of the caliphs. About the middle of the tenth century the rival Mohammedan dynasty of the Fatimids in Egypt conquered it, and in the latter part of the eleventh the Seljuk Turks made it a part of their empire.

The cruelties perpetrated by these fanatics on Christian pilgrims visiting the Holy Land led to the Crusades. Jerusalem was taken by assault (1099), and the whole of Syria, except Damascus and a part of Mesopotamia, was conquered by the Christian princes, and divided into principalities. Godfrey was chosen ruler of Jerusalem, Bohemond reigned at Antioch, Baldwin at Edessa, and the Count of Toulouse at Tripoli. Their rule was of short duration; after repeated attacks by Noureddin and his successors, it was overthrown by Saladin in 1187. The Crusades which followed resulted only in their regaining a few points, in the temporary acquisition of Jerusalem by treaty in 1229, and the final occupation of the whole country by the MEMLUKS in 1291. In 1400 Timur overran the fairest provinces of Syria with fire and sword [see TIMUR], and for a long period the country was the prey of the two contending Tartar powers—Timur's successors and the Memluk sovereigns of Egypt. In 1517 it was conquered by the Ottoman Sultan, Selim I., and from that time to our own it has formed a part of the Ottoman Empire, with the exception of the brief interval of its occupation by the French in 1799–1801. Mehemet Ali, the daring Egyptian ruler, sent his son Ibrahim Pasha to invade it in 1831 with the view of annexing it to Egypt and forming a kingdom independent of the Ottoman Porte. Through the intervention of the European powers peace was concluded in 1833, but in 1839 Mehemet Ali renewed his projects of conquest, secretly supported by France. By the prompt action of Great Britain his ambitious schemes were defeated. A British fleet captured Sidon, Beyrût, and Acre, and in 1841 Syria was restored to the Ottoman Empire, and a great deal of trouble has been entailed upon the unhappy country in consequence.

The feuds between the Christians and Mohammedans in 1860, when about 3300 Christians were massacred at Damascus, afforded France a pretext for interference, and 4000 French soldiers were landed at Beyrût. At the same time sanguinary disturbances, such as had frequently occurred before, broke out in Mount Lebanon, between the Druses and the Maronites, and a predatory conflict of several months' duration followed, in which nearly 150 villages were destroyed. Again Great Britain came to the assistance of the Turkish government, and concluded a convention by which France bound herself to evacuate the country when its pacification was effected; and in June, 1861, the French army re-embarked. About 15,000 perished in all by these unhappy dissensions.

SYRIAC LANGUAGE AND LITERATURE. The Syriac, or Western Aramaic, is a language of the Semitic (or Shemitic) family, and was spoken by the original inhabitants of Syria and Mesopotamia, and after the Captivity in Galilee. It differs very little from the Chaldee, or Eastern Aramaic. The two dialects differ chiefly in their systems of vowel points and in the use of a different character. The modern Syriac alphabet is an easier and more rapid style of writing, adopted from the Estranghelo, or ancient Syriac character, which did not disappear as a living alphabet till the ninth century. It began to come into use in the fifth and sixth centuries, and by degrees crowded out its predecessor, which was at last employed only for headings and similar purposes. Estranghelo is also the parent of Kufic, from which the modern forms of Arabic letters are derived. Finally, we have the Nestorian character, still in common use with modern Nestorian Christians; it is heavier and squarer than the last-named, and less altered from their common mother, the Estranghelo. All the Syriac alphabets contain the same twenty-two characters which the Phœnician and the Hebrew possess. Syriac contains many Greek and Latin words, chiefly nouns; it has also partly filled out the scanty structure of the Semitic verb with forms of periphrastic origin. Thus, besides the usual perfect and imperfect (or preterite and future), each

of which is capable of standing for time past, present, or future, it has a distinctive present, formed by a participle and following pronoun; an imperfect, formed of a participle and the verb to be; a pluperfect, formed of the perfect (or preterite) and the verb to be; and even a future, with the adjective ready, about to. Of the Semitic conjugations, the Syriac has but three, each with its passive; the second and third are hardly distinguished in meaning, both expressing intensive or causative action. The dual number has entirely disappeared.

Ancient Syriac was a vernacular dialect in the time of Christ, and several of its phrases and idioms are enshrined in the New Testament. It continued to be spoken during the first centuries of our era. After being raised to the rank of a cultivated literary language, it maintained itself as such, unaltered, thoughout the whole period of growth of Syriac literature; and it is still the sacred language of the scattered bodies of Christians in Asia representing the ancient Syriac Church. It is no longer properly understood, however, even by the best instructed among them. The vernacular dialect of the once powerful and active sect of Nestorians was in 1880-87, by the efforts of the American missionaries at Urumiah, raised to the rank of a printed language, with a Christian literature, school and scientific books, periodicals, &c.

Syriac literature is Christian, composed under Greek influence and after Greek models; and besides the important part it has played as the intermediary between Greek and Moslem science and philosophy, it is a source of valuable historical information. The oldest Syriac work still existing is the translation of nearly the whole Bible, of unknown authorship, commonly called the Peshito; it is supposed to have been made not later than about A.D. 200. Since it is admittedly older than the oldest existing Hebrew MSS., it is of exceeding value and interest for purposes of criticism. Its merit is, however, very unequal. The earliest authors whose names, with fragments of their works, have come down to us, are a few years older; they are Bardesanês and his son Harmônios. Besides philosophical works, they composed the first hymns in the language, and fixed its poetical style, giving it a properly metrical form, dependent on accent and number of syllables, with occasional rhyme; it was the first time that any Semitic dialect had been subjected to such rules. But the most prominent early Syriac author is St. Ephraem, or Ephraem Syrus, of the middle of the fourth century; with him begins the full career of the Syriac literature, which continued uninterrupted until the ninth century. A great part of this literature has been lost, and what remains has as yet been but partially worked up and made accessible. It may be said to have done its principal work in the eighth and ninth centuries, in introducing classical learning to the knowledge of the Arabs. The grammatical study and culture of Syriac began after the founding of the famous school of Edessa, long a chief centre of Oriental learning, in the fifth century. The works of previous labourers in this field were effaced by those of Jacob of Edessa, of the seventh century, whose authority gave the classical and sacred dialect its final form. From his time the series of native grammarians and lexicographers is almost unbroken till the thirteenth century. The study of Syriac was introduced into Europe in the fifteenth century, and the names of Ambrosius, Widmanstad, the two Ecchellenses, and Assemani are prominent among its cultivators. The only comprehensive dictionary is that contained in Castell's polyglot lexicon, and published separately by Michaelis (Göttingen, 1788). Of the Latin grammar of Hoffman (Halle, 1827), an English abridged translation has been published by Cowper (London, 1858); it has also been worked over and much extended and altered by Merx (1867). The German one of Uhlemann (Berlin, second edition, 1857) includes also a chrestomathy and glossary; this, too, has been reproduced in English by E. Hutchinson (second edition, New York, 1875). A complete lexicon was begun by Bernstein, but interrupted by his death; his collections and Quatremère's passed into the hands of Dean R. Payne Smith, who published a very full and learned dictionary (London, 1876, *et seq.*) Mr. Cureton especially has done great service to students of this interesting tongue by the publication of extracts from the precious collection of MSS. some time since acquired for the British museum from the convent of St. Maria Deipara, in Egypt.

SYRIAN PHILOSOPHY. See ARABIA, section *Literature*.

SYRINGA. See LILAC.

SYR'INGE (Gr. *συριγξ*, a pipe), a portable hydraulic instrument of the pump kind, commonly employed for the forcible ejection of fluids. In its simplest form it consists of a cylindrical tube, with a perforated nozzle at one end, and a piston or plunger, to the rod of which a ring or other convenient handle is attached. The tube being held in the left hand, with its nozzle immersed in water, the piston is drawn to the upper end of the tube by the right hand. The pressure of the atmosphere upon the surface of the water causes it to follow the piston, so that the syringe becomes filled with water. The instrument is then removed from the vessel, and by pushing the piston back towards the nozzle its contents may be ejected with a force proportionate to the power applied. Syringes of various sorts are extensively used for surgical, horticultural, and other purposes. The fire-engine, the garden-engine, the air-pump, and the stomach pump are all examples.

SYR'INGIN is a substance obtained from the bark of the common lilac (*Syringa vulgaris*, natural order Oleaceæ). It crystallizes in colourless needles, having the formula $C_{19}H_{28}O_{10}H_2O$. Upon heating, the water is given off, and anhydrous syringin ($C_{19}H_{28}O_{10}$) is obtained. It melts at 212° C. (413° Fahr.) to a colourless liquid. It is soluble in hot water and alcohol, but not in ether. It gives a dark blue to violet colour with oil of vitriol, and a blood-red solution with nitric acid. It is a glucoside, and when heated with dilute hydrochloric acid yields a fermentable sugar and syringenin ($C_{13}H_{18}O_5$).

SY'RINX (Gr. *συριγξ*, a pipe) was a nymph of Arkadia, beloved of the god Pan, from whose embraces she was endeavouring to escape when at her prayer the gods changed her into the reeds waving above the river Ladon, into which she had plunged in her fear. Pan drew the reeds and fashioned them into pipes, which he made into a syrinx or Pan's-pipes. [See PANDEAN PIPES.] This is the Greek myth, but the origin of the instrument, which is known to many early nations, is of course variously given in the traditions of each one. The word syrinx comes from the Greek *surizô*, to pipe or whistle, an admirable example of onomatopœia or sense-sound.

SYR'PHIDÆ is a family of insects belonging to the order DIPTERA and section Brachycera, containing numerous genera, a great portion of which have representatives in our islands. The species are flower-lovers in the perfect state, and many of them are large, brightly-coloured flies, remarkable for their vigorous flight. There is considerable variety in form and colour in this family, some species of which are parasitic in the nests of humble-bees and wasps, mimicking the appearance of those insects most closely. The head is convex in front and concave behind, with the eyes large, especially in the males, and with three ocelli. The antennæ are three-jointed, the last joint bearing a curved bristle, which is sometimes beautifully feathered. The transparent wings are characterized by the presence of a false vein, intersecting the short transverse vein between the third and fourth longitudinal veins; and the cells formed by the longitudinal veins are generally cut off from the margin of the wings by a transverse vein. The species of the typical genus, Syrphus, of which about

thirty are British, are very abundant in gardens, fields, lanes, and woods during the summer, feeding on the juices of flowers, especially of composite plants. They may be often seen hovering over flowers, apparently motionless, the motion of the wings being so rapid as to be almost imperceptible. Many of the species much resemble wasps, and the larvæ confer great benefits on the farmer and gardener by destroying great numbers of Aphides or plant lice. *Syrphus pyrastri* is a common British species, about half-an-inch long, with the body blue black, striped on the thorax with tawny colour, and with three yellowish bands on the abdomen. The larva is a whitish, footless leech-like grub, which crawls on its flattened under surface in the manner of a slug among the leaves and twigs of plants infested by Aphides. The front part of the body is narrowed, and there is no distinct head, but the mouth is furnished with a sort of trident, with which the larva transfixes its prey and holds it raised in the air until all its juices are extracted. The change to the pupa state takes place within the skin of the larva, and the pupa is a long pear-shaped or flask shaped brown body, which remains attached to a leaf or twig.

The species of the genus Volucella, which are more stoutly built, are parasitic in the larval state in the nests of humble-bees and wasps, whose appearance is imitated in some cases by the perfect insects very exactly. *Volucella bombylans* is about half-an-inch long, with a black hairy body, remarkably resembling that of a small humble-bee. This species enters the nests of humble bees to deposit its eggs, and its larvæ when hatched feed on the larvæ of the host. The DRONE-FLY (*Eristalis tenax*) is another species of this family remarkable for the aquatic habits of its larva. The larvæ of other species of this genus, as well as those of several allied genera, live in rotten wood; in other members of the family the larvæ feed on bulbous roots, and some on decaying vegetable matters and fungi.

SYRRHAP'TES. See SAND GROUSE.

SYR'UPS (Arabic *srb*, through the Latin, whence also *sherbet*, *sorbet*, and the common liqueur called *shrub*) are medicinal solutions of sugar, either in water alone, as in simple syrup, or in liquids charged with some peculiar principle of an active kind, such as senna or buckthorn, or merely grateful from their colour or fragrance, or both, such as syrup of violets. These must be made of a proper consistence, either by having a suitable quantity of sugar added to the water first, or by subsequent evaporation of the superfluous water. The former is the preferable mode, as the syrup keeps better. The purest and most thoroughly refined sugar should be employed, and generally in the proportion of two parts of sugar to one of fluid. In the manufacture of sugar all solutions which contain sugar in such a condition that it may be removed by crystallization are termed syrups, the residue left after crystallization being called molasses or treacle. In commerce the refined treacle sold for table purposes is commonly called golden syrup.

SY'RUS, PUBLIUS, was a Syrian slave (*Syrus*) whose name was unknown. As he belonged to a Clodius he adopted the gentile name of the family, Publius. His ready wit induced his master to put him on the stage, and he soon was regarded as the prince of mimics. He was an accomplished man, and wrote his own farces; many of them were in circulation in early times, and St. Jerome mentions a book filled with his witty and wise sayings. The present collection passing under his name ("Publii Syri Sententiæ") is evidently a compilation from many sources, probably the bulk may have come from Syrus. The best editions are by Crelli (Leipzig, 1822) and Bothe (1834). The date of Publius Syrus was in the third quarter of the last century before Christ.

SYSTEM, in astronomy. This term is applied to every theory of the disposition and internal arrangements of the solar system, or of the material creation generally. Thus we have the system of Ptolemy (Ptolemaios), of Copernik (Copernicus), &c. Perhaps a short description of the distinctive characters of the different systems may be useful in a work of reference.

Ptolemaic.—The earth is an absolutely fixed centre, and the planets revolve in circles about centres which themselves revolve round the earth.

Copernican.—The sun is a centre, round which the planets revolve. Some of the machinery of the Ptolemaic system is retained.

Tychonic.—The sun is a centre of motion to all the planets which revolve round it, while the sun and planetary orbits are carried together round the earth as a fixed centre. This is the system of the great Tycho Brahé.

Semi-Tychonic.—The sun is a centre of motion to Mercury and Venus, as in the Tychonic, and the motions of the other planets are as in the Ptolemaic system.

Newtonian.—There is no fixed centre, the sun only approximating to that character from its greater magnitude. The orbits of the planets are approximately represented by ellipses; exactly by ellipses of which the elements vary. The Newtonian system is frequently called Copernican, from its rejecting what Copernicus rejected, but it is far from receiving all that Copernicus received. The introduction of the ellipse is due to Kepler. We have not included the system of Descartes, because it has reference to physical causes, and contains no peculiarity of arrangement.

The term system is also applied to the subdivisions of the solar system; thus we have the Terrestrial, Jovian, Saturnian, Uranian, and Neptunian systems.

SYSTEM, in mathematics, a word little used; we hear sometimes of a system of equations or a system of curves or surfaces, the former meaning a set of equations which are related to each other in the same problem, the latter a class of curves or surfaces which are connected by any law.

SYSTEM, in the musical language of the Greeks, had much the same signification as the word SCALE has in modern music.

SYSTEM, NERVOUS. See NERVOUS SYSTEM.

SYS'TOLE (Gr. *sustolê*, a contraction), in grammar, the poetical license by which a long syllable is used as short; in medicine, the contraction of the heart, opposed to diastole.

SYS'TYLE, in classic architecture, a mode of arranging the columns of a temple in which the intercolumniation or space between the columns is equal to twice the diameter of the column.

SYZ'YGIES and **QUAD'RATURES.** The syzygies of a planet or of the moon are those points of its orbit at which it is in conjunction or opposition with the sun; the quadratures are the precisely intermediate positions. Thus at new and full moon the moon is in syzygy; at half moon in quadrature.

SYZY'GIUM is a genus of plants of the order MYRTACEÆ. The species are trees or shrubs, natives of tropical Asia and Africa. The flowers have the calyx undivided, and the petals inserted on to the throat of the calyx, united together into a hood, and soon dropping away. *Syzygium guineënse*, a native of the coast of Guinea and Senegal, has been employed as a remedy in rheumatism. In the Gambia district the plant is an object of worship, and the fruits are eaten. *Syzygium Jambolanum*, a native of the East Indies, and most extensively diffused, is planted near villages in clumps of trees, chiefly on account of its fruit, which is sometimes called Java Plum by Europeans, but Jamoon by the natives. The bark is astringent, and is used medicinally. The timber is hard and durable.

SZEGEDIN', the capital of the Hungarian county of Czongrad, is situated on an eminence on the right bank of

the Theiss, opposite its junction with the Maros, 118 miles south-east of Pesth by railway. The city is strongly fortified. It is divided into the central town called Palenka, which has well-built houses, but unpaved streets; the citadel, which is surrounded with walls and moats, and includes some barracks, the upper and the lower suburbs, and a street called Kukurntz-Varos, or the corn market. The population of the whole is about 65,000. The chief buildings are numerous churches, a synagogue, the county-hall, the house of correction, the town-house, and the great salt magazine. There are a gymnasium, a high school, several hospitals, a military school, a workhouse, and a theatre. The town was terribly injured by a great flood in 1879. The trade consists in salt from Transylvania, tobacco and corn from the Banat, timber and wooden wares from Transylvania, horned cattle, hops, and wool, and it is an important cattle market. The most important industrial products are tobacco, snuff, soda, soap, and coarse cloth. Nearly all the cotton imported into Austria from Turkey passes through the town to Pesth and Vienna. The town has the largest wharves on the Theiss, and has long been noted for its build of river craft, which are the best in Hungary. Szegedin in the time of Matthias Corvinus was one of the most important cities in Hungary. It was taken by the Turks under Soliman II. after the Battle of Mohacs, 26th August, 1526, and remained in their possession till 1686, when it was retaken by the Austrians soon after the defeat of the Turkish army by Sobieski under the walls of Vienna. The city was the seat of the insurgent government in July, 1849; it was taken on 3rd August of that year by the Austrians under Marshal Haynau, on their advance against the insurgent army at Temesvar.

T

T is the surd letter of the dental group of mutes, its corresponding sonant mute being *d*, and its nasal *n*. The Semitic name, *Tau*, signifies a mark like a cross.

1. *T* is interchangeable with *c*, as Lat. *nuc* (*nux*), Eng. *nut*. [See C.] The resemblance of these letters in Latin manuscripts is so close that it is often difficult to distinguish them. Hence there is much uncertainty in the orthography of many words in that language. Yet there is no doubt that *contio*, an abbreviation of *conventio*, and *nuntius* or *nountios*, of *novi-ventius* (compare *nov-i-tius*), should be preferred to the forms *concio*, *nuncius*.

2. It is interchangeable with *d*, as proud (old French *prut*), bud (Fr. *bout*), diamond (Fr. *diamant*), card (Fr. *carte*, Lat. *charta*).

3. *T* is interchangeable with *th*, whether as pronounced in *thin* or in *the*. Thus the Latin *t* corresponds for the most part to *th* in English, and *tu*, *tres*, *tenuis*, *pater*, *mater*, of the Latin language, severally correspond to *thou*, *three*, *thin*, *father*, *mother*, of the English. The termination of the third person in the Latin and old English verbs presents the same analogy, as *amat*, *loveth*. It is also, 4, interchangeable with *p t* [see P] and, 5, with *s* [see S].

6. *T* is interchangeable with *st*. This interchange might be inferred from the preceding. Examples exist in *art*, *wilt*, *shalt*, compared with the usual termination of the English second person.

7. It is interchangeable with *l*. Thus the Latin words *lingua* (also *dingua*), *lacr-uma* (also *dacr-uma*), *lacerare*, *ligare* (also *dicare*), severally appear in English as *tongue*, *tear* (subst.), *tear* (verb), *tie*. Hence Gr. *heteros* is allied to the Latin *alter*, and *mitis* of the Latin to *mild* in English. Compare also the Latin *ali-quod*, &c., with the German *et-was*, &c.

8. It is also interchangeable with *nd*—perhaps not a common change. Examples are, Lat. *et*, Ger. *und*, Eng. *and*; Lat. *sed* or *set*, Ger. *sond-ern*, Eng. *sund-er*, *sund-ry*, &c.

9. *T* disappears from the beginning of words before *l*. [See L.] On the other hand it is added at the beginning of the word *tante* in French, the old French form being *ante* (whence our "aunt"), and the original Latin *amita*.

10. *T* in the middle of words, when flanked by vowels, often disappears. Our words *best*, *last*, were in their earliest forms *betst*, *latst* (latest). Thus the Latin words *pater*, *satis*, *vita*, *amatus*, *amata*, reappear in French as *père*, *sez* (in the compound *as-sez*, from *ad-satis*), *vie*, *aimé*, *aimée*.

11. *T* at the end of words is frequently dropped. Of the omission of a final *t* in pronunciation, the French language has numerous examples, as in *et*, *fait*, *est*, &c. It is very probable that a final *t* has in this way disappeared from the third person singular of many tenses in the French verb, as *il aime*, *il aimera*, *qu'il finisse*, &c. In the interrogative form *aime-t-il*, the interposed *t* really belongs to the verb, and owes its preservation in this form to the fact that a vowel follows. Even the Greek language drops this *t* in the suffix of the third person, as in *tuptei*, *etupte*, for *tupteti*, *etuptete*. Compare the middle forms *tuptetai*, *etupteto*. So also we have *anvil* from Old English *anfilt*, *dandelion* from *dent de lion*, *petty* from *petit*. But on the other hand it may be added; as *tyrant* from *tyran*, *parchment* from *parchemin*, *ancient* from *ancien*.

12. *Th* also varies much. It has largely changed into *d*; as *murder* from Old English *myrthra*, *fiddle* from Old English *fithele*, *dwarf* from Old English *thweorh*, later form *dwergh*, &c.; or into *t*, as *theft*, from *theofth*; or into *s*, as *sees*, *loves*, from *seeth*, *loveth*. [See also under the letter S.] It disappears in *Norfolk*, *Suffolk*, &c., from *North-folk*, *South-folk*, &c.; and in *worship*, from *weorth-scipe*.

13. *Ti* before a vowel is often changed to a sibilant represented by *s*, *sh*, *ch*, &c. Thus from the Latin *faction* (*factio*) are derived the French *façon* and the English *fashion*. So *avaritia*, *malitia*, *vitium*, become in French and English *avarice*, *malice*, *vice*.

TABAN'IDÆ. See GADFLY.

TAB'ARD, in heraldry, a garment worn by knights during the latter half of the fifteenth and the early part of the sixteenth centuries, and consisting of a short frock with wide sleeves reaching to the elbows, and the armorial bearings of the wearer blazoned on the back and front. It is still worn as the official dress of heralds, who, however, bear the arms of their sovereign.

TABASHEER' is a substance secreted in the stems of bamboos, especially in their joints. It is an OPAL, consisting essentially of silica in its colloidal form, with a small mixture of lime, potash, and organic matter; some specimens obtained from the Andes by Humboldt contained only 70 per cent. of silica. The tabasheer obtained from India, China, &c., is of two kinds, crude and calcified. The former consists of roundly-angular pieces of irregular sizes, possessing all degrees between transparency and opaqueness, and varying in colour from brownish, reddish, yellowish, and dark gray to black. The latter exhibits the phenomena of *opalescence*, being of bluish-white colour by reflected light, and yellowish by transmitted light. Tabasheer appears to originate from the deposition of silica in large quantities in certain places by the sap of the plant, but whether in consequence of disease is not clearly known. It is found at times in the form of a fluid, usually clear and transparent, either colourless or of

a greenish tint, sometimes thicker and of a white colour, and at other times darker and of the consistency of honey. Dr. Russell found the thicker varieties passing into the solid state; and by drawing off the liquid from the bamboo-stem into bottles, and allowing it to evaporate, a residuum was left of a whitish-brown colour resembling the inferior kinds of tabasheer. Sir David Brewster, who investigated the physical properties of tabasheer, found that it possessed a lower refractive power than any other known solid or liquid, holding an intermediate position between water and gases. It absorbs water very readily, and when thoroughly saturated becomes perfectly transparent. When heated it exhibits the property of phosphorescence in a remarkable degree. According to Professor Judd (*Nature*, March, 1887) the singular properties of tabasheer show that it is "a very intimate admixture of two and a half parts of air with one part of colloidal silica."

From time immemorial tabasheer has enjoyed a high reputation in Eastern countries as a drug, being supposed to possess tonic properties. Ground into powder it is often chewed with betel. It was made known in Western Europe through the writing of the celebrated Arabian physician Avicenna, who lived from 980 to 1037 A.D.; he is said to have introduced the name, which is Persian and signifies "condensed milk-sap," into the Arabian language. In the middle ages it was a highly valued remedy in fevers and dysentery. (See an interesting discussion on this subject in *Nature*, February to May, 1887, by Professors Thistleton Dyer, Judd, and others.)

TAB'ERNACLE, in the Roman Catholic Church, is a small structure in which are deposited the consecrated elements of the Eucharist. It is used for no other purpose, and its key is exclusively in charge of the clergy. It may be of wood, marble, or metal, but if either of the latter, it has also a lining of cedar wood, overlaid with silk. The name is given it as typical of the tabernacle of the Mosaic law. Its proper place is the back of the altar, and a lamp is kept constantly burning before it.

TAB'ERNACLE (Lat. *tabernaculum*, tent; Heb. *mishcan*, dwelling; *ohel*, tent), the sanctuary set up by the Israelites during the period of their sojourn in the Sinaitic desert, and which, after their entry into Canaan, was set up at various places until it was replaced by the temple of Solomon. According to the Book of Exodus it was constructed by order of Moses by two skilled workmen, Bezaleel, of the tribe of Judah, and Aholiab, of the tribe of Dan, assisted by a body of male and female workers, and set up for the first time on the first day of the first month in the second year after leaving Egypt. Two descriptions of the structure are given, in Exodus xxvi. and xxxvi. 8–38, the latter account being but slightly abridged from the former, and Josephus in his "Antiquities" (iii. 6) gives a description in which a few details only are added to the Biblical account. From these descriptions we learn that the whole structure was 30 cubits long by 10 broad, or about 45 feet by 15, the height to the inner roof being 10 cubits. The outer coverings seem to have been stretched over a ridge rising some 5 cubits above the centre, and to have been made to extend a similar distance beyond the wooden framework on either side. The framework consisted of forty-eight boards of acacia wood, each board being 10 cubits high and 1½ broad, and all plated over with gold. These boards were placed perpendicularly, being fitted by double tenons into silver sockets, twenty each for the north and south walls, and six, with two angle boards or posts, for the west end of the structure. These boards were held together by means of bars of acacia wood passed through rings of gold, and made to fit into each other at the ends, the end wall having one continuous bar passed through the rings, into which the ends of the bars of the sides were inserted. The entrance of the tabernacle at the east end was closed by a curtain supported by five columns, the centre one probably rising higher than the others to support the ridge of the roof, and internally the structure was divided into two apartments. The inner apartment, a cubical chamber, 10 cubits square, on each of its sides, and containing the ark of the covenant, formed the Most Holy Place, and this was left for the greater portion of the time to darkness and silence, being only entered by the High Priest, and by him only on extraordinary occasions. The outer chamber, called the Holy Place, which was used by all the priests, was 20 cubits long by 10 broad, and 10 high, and it contained the golden table of shewbread on the north side, the golden candlestick on the south side, between them in the centre being placed the altar of incense. The roof of the tent was formed of four sets of curtains, the innermost being of fine twined linen ornamented, coloured, and marked with figures of the cherubim, and over this were thrown a set of goat's-hair cloth, another of ram's skins dyed red, and a third of seal-skins or porpoise skins for the outside covering. The curtain which separated the two chambers was stretched upon four pillars, and was of the same material as the innermost curtain of the roof.

The tabernacle stood in an inclosure of curtains 50 cubits or 75 feet wide, and 100 cubits or 150 feet in length, the curtains, 5 cubits in length, being supported upon brass pillars, and the east end being provided with an entrance 20 cubits wide. In the east end of the court thus formed was placed the altar of burnt-offerings, and the laver for the ablutions of the priests.

The typical significance of the tabernacle has been a subject of investigation from the times of Philo and Josephus at least, and a limited explanation of this symbolism is given in the New Testament by the anonymous author of the Epistle to the Hebrews. Greatly enlarged and also greatly divergent explanations have been subsequently proffered by Jewish and Christian expositors. Among the more important treatises on this subject in modern times may be mentioned the "Symbolik des Mosaischen Cultus" of Creuzer (two vols., Hidelberg, 1857–59), and the "Symbolik der Mosaischen Stiftshütte" of Friedrich (Leipzig, 1841). Under PENTATEUCH we have noticed some of the more recent theories concerning early Hebrew history, and it will be only necessary to mention here that by some modern critics the whole of the details concerning the tabernacle and its source are relegated to the realms of pious invention. According to the Old Testament narrative the tabernacle formed the model to a considerable extent for the temple of Solomon; but in the theories referred to this order is inverted, and the tabernacle is supposed to be an imaginary structure, the details of which are suggested by those which are recorded concerning the first temple, though it is not denied that the Hebrews may have used a sacred tent for devotional purposes during the earlier periods of their history. See also ARK OF JEHOVAH, SHEKINAH, and TEMPLE.

TABERNACLES, FEAST OF (Heb. *haghassukoth*), one of the three great festivals of the Jews, the time of the observance of which fell in the autumn and extended from the 15th to the 22nd Tisri (October). It came at the close of the agricultural labours of the year, after the corn, and wine, and oil had been gathered in, hence its name "the feast of ingathering" (Exod. xxiii. 16), and it was also associated with the period of the wilderness journeyings, which it served to commemorate. In the earlier periods it would appear that the people were accustomed to quit their houses and to resort to huts or tents erected in the fields; later on in their history the booths were erected in their courtyards and gardens and on the flat roofs of the houses. The sacrifices appointed for the festival consisted of seventy bullocks, thirteen of which were offered on the first day, the number being diminished

by one each succeeding day to seven on the last, and two rams, fourteen lambs, and a goat daily, with meat and drink offerings. By a traditional gloss of the scriptural injunction to "take boughs of goodly trees," &c. (Lev. xxiii. 40), each worshipper was enjoined to make a bunch of green branches, called a *lûlâb*, to be carried in his hand, and to take a citron in the other for processional purposes in the temple. Where he could not visit the temple he was merely required to say a benediction over his *lûlâb* on the first day of the feast. At the time of Jesus certain observances were connected with this feast to which no reference can be found in the Old Testament. One of these was the ceremony of drawing water by a priest from the pool of Siloam, which was carried in a golden vessel into the temple, the procession being attended with the sounding of trumpets, and with song, and the pouring of this water into a silver basin on the west side of the altar. A vessel of wine was at the same time poured into a similar receptacle on the east side of the altar. Another observance was that of the illumination of the court of the women each night by the light of four huge stands of lamps, and the performance there of torchlight dances by the worshippers. Of all the Jewish festivals this was the most joyous, one proverb asserting that "He who has never seen the rejoicing at the pouring out of the water of Siloam, has never seen rejoicing in his life." On the eighth day the branches of boughs were laid aside, the booths and arbours pulled down, and a special sin offering was offered in expiation of offences that might have been committed during the festival. The feast is still observed by the Jews, and in some countries they continue to observe as many of the ordinances as their altered circumstances will admit of.

TABER'NÆMONTA'NA is an extensive tropical genus of plants belonging to the order APOCYNACEÆ. All its numerous species are either shrubs or trees, with opposite entire leaves and cymes of fragrant white or yellow flowers, generally in pairs at the extremities of the branches. They all possess a milky juice of an agreeable flavour and wholesome quality. *Tabernæmontana utilis* (the Hya-hya or cow-tree of British Guiana) yields, when tapped, an abundance of milk, more viscous but scarcely less pleasant than that of the cow. Its bark is used by the Indians for medicinal purposes.

TA'BES DORSA'LIS, a term formerly used in medicine to designate a condition of debility caused by excessive sexual indulgence or abuse of the generative functions, and characterized especially by failure of nervous power. At the present day its use is restricted to the form of nerve disease more commonly known as *locomotor ataxy*, which may arise from prolonged exposure to cold and wet, bad or insufficient diet, excessive and prolonged fatigue, and syphilis, as well as from sexual excess. The premonitory symptoms of the disease are varied and obscure, but in many cases the earliest signs are the occurrence of sharp shifting pains in the muscles of the legs, attended by feelings of weakness and inability to walk steadily. At first the patient walks like a person partially intoxicated, and his feet feel numb and as though they were covered with fur. As the disease progresses he becomes unable to stand alone in the dark or with his eyes shut, and when he attempts to walk he proceeds with a kind of prancing gait, bringing his heels to the ground with a sharp kick. Gradually the loss of power over the muscles extends to other parts of the body; the hands and arms become affected, there is incontinence of urine and loss of virile power, there may be squinting, double vision, or amaurosis, and towards the close disordered functions of the heart are observed. The disease is almost restricted to males, and is seldom observed earlier than the middle period of life. The prognosis of the affection is generally unfavourable, but when it is dealt with in its early stages much benefit may be derived from treatment. The patient should be carefully protected from cold and wet, he should be sustained by a good and generous diet, and he should secure as much rest and fresh air as possible. The medicines which appear to exercise the most beneficial influence over the disease are nitrate of silver, oxide of silver, and physostigma, while the pains in the limbs may be relieved by the cutaneous injection of morphia. The bowels must be kept open, as constipation always increases the pains felt. Among local measures, dry-cupping along the spine and the use of the constant galvanic current appear to be the most useful.

TABI'NET or **TABBINET,** the name formerly given to a kind of rich silk and other stuffs, watered or figured by being passed through a calender, the rollers of which are variously engraved.

TABL. See TABOR.

TAB'LATURE, the ancient notation for lutes and for certain pipes: consisting, in principle, of a designation of the frets of the lute or holes of the pipe by separate letters or signs. In just the same way the Tonic Sol-fa and Chevé musical notations designate the degrees of the scale by letters or figures instead of writing them down in an independent musical notation, and thus form the midway stage from tablature to true writing.

On the lute, as we learn from the famous "Tablature" published by Adrien le Royat (Paris, 1570), and translated into English in 1574, there were eight frets, each rising a semitone, and lettered from *a* to *i* in the tablature, and six strings. The lowest string was *c*, and the highest *c''*, and the tuning was by Fourths; two strings out of the inner four being tuned from *c* by Fourths up, giving respectively *f* and *b♭*, and two from *c''* by Fourths down, giving respectively *g'* and *d'*.

A stave of six lines represented the six strings, and the letters of the tablature were written above that string to which they applied. The open string was denoted by the letter *a*, the first fret (placing the finger on which shortened the string by a semitone) by *b*, the second by *c*, and so on.

Taking the third string (*d'*) of the lute as an example, its tablature would represent the above scale in our ordinary notation, ranging from *d'* to *b♭'*. The illustration also shows part of the tablatures of the second and first strings.

Consequently "God Save the Queen" would appear in our ordinary writing and in lute tablature respectively as follows:

"God save the Queen" (E♭), Ordinary notation.

"God save the Queen" (E♭), translated into lute tablature and playable on the third string of the lute (*d'*)

The time-signs were written above the tablature stave, as in the preceding illustrations, but the well-known hooks here used are not the actual tablature signs, and serve only to illustrate the principle. When once a time-sign is given in tablature, all the notes afterwards are of like length until corrected by another time-sign.

The "Italian tablature" was by figures instead of letters, and was in constant use in England as well as in Italy.

Music for viols was written either *gamut-way* (ordinary notation) or *lyra-way* (tablature).

The tablature for pipes (as for the wait or hautboy, flageolet, &c.) came rather later, and was written by dots between lines of a stave, the time being indicated above the music. The stave had as many spaces as the pipe had holes, and the number of dots read in a vertical line showed the number of holes to be stopped by the fingers. "God save the Queen," played upon a common whistle pipe with six holes, would be written thus in tablature:—

"God save the Queen," translated into tablature for a common whistle-pipe with six holes.

The pipe with all holes open would give the Seventh of the scale in the lower octave. Pipe tablature was used in a work for the flute printed in 1704; lute tablature had died out a few years before.

TABLE BAY, a bay on the west coast of Cape Colony, South Africa, opening north-west, about 7 miles wide at entrance, and 5 miles long. It is deep seaward, gradually shelving from the coast, where it is shallow. It is somewhat unsafe during the three winter months—June, July, and August—from the prevalence of north-west winds; but it is capable of containing the largest fleets. Formerly all the shipping trade was carried on in the open bay, where in ordinary weather vessels were secure enough, but in north-westerly winds they were exposed to long rolling seas. In the gale of 1865, no fewer than eighteen vessels out of twenty-eight at the anchorage were wrecked. The port now, however, offers good shelter in all weather, a breakwater, 2000 feet in length, inclosing a large area where ships may lie safely, having been constructed; inside of this are docks, consisting of an outer and inner basin, forming together an area of 16 acres, affording accommodation for from eighty to ninety vessels.

TABLE MONEY is an allowance granted to general officers in the army, and flag officers in the navy, to enable them to practise an hospitality befitting their station and the importance of their command. It varies from £1 to £4 10*s*. per day, according to the locality, the regiment or ship, and the rank of the officer in command.

TABLE MOUNTAIN, a mountain rising very steeply in South Africa, to the south of Cape Town, to the height of 3550 feet. Its lower slopes close to the town are covered with villas and gardens, looking north towards the mid-day sun; and further up it presents lofty cliffs north towards the bay, and east to the gap or low isthmus called the Table Flats; these extend toward Simon's Bay. It descends west towards the Atlantic, first in precipices, then in steep slopes, till it joins the Lion's Head (2180 feet high) and Rump, a sort of buttress to it, or advanced terrace. It is composed of granite through two-thirds of its vertical height, the upper part being sandstone in horizontal strata, with Silurian fossils. Granite also forms the substratum of the same district, and primary slates occur under the Lion's Rump and in the west of the peninsula. The Blau Berg range, and the parallel group of the peninsula, consist of flat-topped mountains, varied with pointed peaks, and separated by deep gorges. When the wind blows off the sea, a striking phenomenon is witnessed; the broad flat summit of Table Mountain is covered with masses of white vapour, called the "Table-cloth" in Cape Town, which, urged forward by the wind, and supplied by constant accessions of newly condensed vapour, roll over the face of the cliffs, and descend as if to envelop the town; but when they reach a certain level, they are in a moment dissolved by the warm stratum of lower air in shelter of the mountain.

TABLEAUX VIVANTS (a French phrase, "living pictures"), a now popular entertainment, introduced into England from France and Germany, wherein scenes from the works of poets, painters, or novelists, historical incidents, and imaginary situations are represented by groups of appropriately dressed persons. To heighten the effect, the room in which they take place is darkened, and the actors, who do not speak, sometimes take up their respective positions behind a frame covered with gauze, the lights being so disposed as to illuminate the group from above.

TABLE-LANDS. See PLAINS.

TAB'LETS (Lat. *tabulæ*, *tabellæ*), the memorandum books of the ancients, were thin pieces of wood framed like our slates, and coated with wax. A pointed rod, usually of metal (the *stilus*), served to write upon the tablets; and the name of this rod has come to mean by analogy the character of the writing, as when an elegant Latin writer might figuratively be said to write with the *style* of Cicero. Tablets of the wealthy were made of ivory or of rare woods; one side only was coated with wax. The protecting rims might be hinged together; and several sets of three, thus hinged, were found in the house of the banker Jucundus, at Pompeii, forming in fact his account books. Sometimes five or six tablets were so fastened. When important documents (as wills, &c.) were written on tablets, the frames were perforated, and a cord passed through the whole, which was sealed to prevent tampering. An unsealed set of tablets was invalid as a legal proof. Writing was easily erased and corrected on tablets, and the upper end of the stilus was flattened into a broad blade for that purpose. To "open the tablets" was equivalent to obtaining confidence. Thus our great master of the human mind appropriately uses the classical expression—

> "And wide unclasp the tables of their thoughts,"

in his classical play of "Troilus and Cressida" (iv. 5). Shakespeare has also emphasized the ease of erasure from tablets, turning it to his own purpose in the fine figure of a forgiving king:—

> "And therefore will he wipe his tables clean,
> And keep no tell-tale to his memory."
> "2 *Henry IV*." iv. 1.

In fact, the image was a favourite one with the poet, and frequently served him. Who has not quoted Hamlet's cry after hearing the revelations of the ghost?

> "My tables! meet it is I set it down
> That one may smile, and smile, and be a villain."

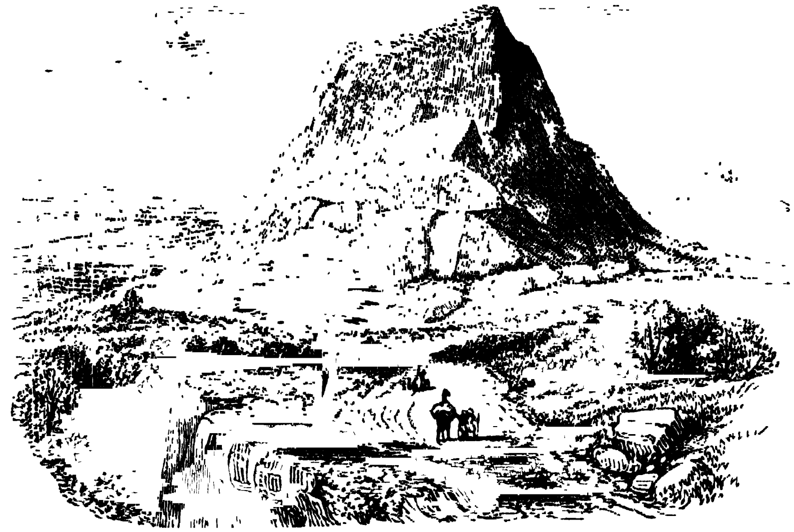
TABLI'NUM, the study or office of a Roman gentleman, so called from the *tabellæ*, or private memorandum and account books kept there. It was the business room of the house, and was usually a sort of large open hall lying between the peristyle and the atrium, and therefore available to the master both for communication with the interior of the house and the more public reception-room. But although the master of the house could survey both divisions, and could pass to them from the tablinum, it was not the proper way of penetrating to the inner chambers. For this purpose a corridor served, connecting the atrium with the peristyle along the side wall of the tablinum.

TABOO', TABU', or more correctly *Tapu*, a Polynesian term designating an institution of immense importance in the Polynesian islands, and one which formerly flourished to a great extent among the Maories of New Zealand.

Used in one sense, the term signifies consecrated, sacred, holy, and used in another sense it conveys the meaning of accursed, evil, and forbidden. In either case it conveys the idea of prohibition, and used in this sense it has now become part of the English language, in the word *tabooed*, *i.e.* forbidden. Thus all the houses or temples of the gods are *tapu*, or sacred, and persons fleeing to them in times of war or tumult are protected by their sanctity, while on the other hand certain places which are considered to be the homes of evil spirits are *tapu*, and all persons are forbidden to visit them. In political life, the person of a chief is protected by *tapu*, it being an offence for any inferior person to touch him, and further, he is invested with extensive powers of declaring actions or articles *tapu*, or of removing this restriction for purposes of government. In social life *tapu* is used to enforce certain observances which are considered necessary and proper, and to forbid actions of an opposite character. In some cases the reason for the use of *tapu* are not far to seek, but its influence extends to many things in which we should hardly expect to find it, and in many instances it forms a terrible restraint and burden upon the life of the people. In those districts which have come under the influence of Europeans the power of *tapu* is rapidly disappearing, but it is still a powerful superstition in many of the islands of the southern hemisphere.

TA'BOR ("mound" or "mountain height"), a celebrated mountain of Palestine, on the borders of the territories of Issachar and Zebulun, in the north-eastern part of the plain of Esdräelon. It is an isolated mass of cretaceous limestone, an elongated oval in shape, rising about 1900 feet above the sea-level. Here Barak assembled his troops (Judg. iv. 6, 12, 14). It is again mentioned in the wars of Gideon (viii. 18). It was long supposed to have been the scene of the Saviour's Transfiguration, but this event much more probably occurred on one of the spurs of Hermon. Its summit was at one time occupied by a walled town. It is easily ascended on horseback, and the traveller obtains from its crest a view of surpassing extent and beauty. Its summit is covered with a confused mass of broken walls, towers, cisterns, and houses, some of which indicate the sites of the convents and churches erected by the Crusaders. The Latins have an altar here; and two or three vaults have been converted into a Greek chapel, with a residence for the priest. Tabor is now known as Jebel-el-Tur, and it is finely described in Dean Stanley's "Sinai and Palestine."

TA'BOR, the *toph* of the Bible, was a small drum-like instrument, akin to the tambourine, but without jingles. The Old English "pipe and tabor" resembled in principle the modern "galoubet and tambourin" of Provence. The pipe was a little instrument with three, or at the outside four holes, and was held to the mouth and played by the left hand, while the right beat the tabor, hung by a cord from the neck, with a light drumstick, or with the knuckles. Shakespeare has a neat contrast between the characteristic instruments of war and peace, where Benedick says of the love-sick Claudio, "I have known when there was no music with him but the drum and fife; and now had he rather hear the tabor and the pipe" ("Much Ado about Nothing," ii. 3). The very similar instrument, but akin rather to the kettle-drum than the tambourine, used now in Egypt,



Mount Tabor.

and called *tabl*, or *tabl shamee*, has usually a copper body; earthenware and wooden specimens are also common. The performer hangs it round his neck and plays on the parchment with a very light pair of drumsticks, the face of the *tabl* being vertical and not horizontal. It is the great instrument for festal processions. The wooden *tabl* of the musahir or crier of pious sentences during the nights of the month Ramadan, is called *baz*; it differs somewhat from the first, and is held in the left hand by a knob at the back, while the right hand beats it with a strap or a stick. These *tabls* measure about 6 inches across the drumhead.

TA'BORITES, THE, a Hussite sect in Bohemia, founded by John Ziska, of Troeznow, early in the fifteenth century. They derived their name from the fortress of Tabor, near the Luschnitz, which they successfully held against the imperial army in 1420. In 1422, under Ziska, they defeated the imperialists at Deutschbrot, and two years later constrained Prague to submit to most unfavourable terms of peace. Their career of victory, under various leaders, continued for many years; but the Calixtines, another sect of the Hussites, joining the Roman Catholics, the Taborites met with a severe repulse at Böhmischbrot, 30th May, 1434. They prolonged their resistance, how-

ever, by a series of desultory hostilities, until their possessions and privileges were secured to them by an ordinance of King Ladislas, 1485. They gradually merged into the more comprehensive sect of the Bohemian Brethren, which arose in their bosom.

TABRIZ' ("the mountain town") is the principal town of Azerbijan, in Persia. It is the emporium of the trade of Persia with Europe through Turkey, and has silk and cloth manufactures. British calicoes were formerly extensively imported, then dyed blue, and sent out as native products. Indigo, an article of great consumption, is obtained direct from India. Several streets are devoted to the sale of particular goods, as one for saddlery, another for silks. The climate is remarkable for extremes of temperature, great heat in summer and severe cold in winter. According to a register of the weather, Fahrenheit's thermometer, which stood frequently at 94 degrees in June, never rose above zero when exposed to the open air at night from the middle of December to the close of January, and was seldom above 18 degrees within doors at mid-day. But Tabriz is accounted healthy, and has therefore been rebuilt after repeated demolition by earthquakes. The present population is about 160,000. It is situated at the junction of the high roads leading to Teheran, from Tiflis on the north and Trebizond on the west, and the Anglo-Indian telegraph line passes through it. It has an English consulate, but contains no remarkable buildings except the citadel, originally a mosque, over 600 years old. At one time, however, it possessed a large number of khans, splendid mosques, public baths, and a population of 550,000. The town has been frequently destroyed by earthquakes. It is rarely free for a twelvemonth from slight shocks, and lost nearly all its inhabitants by a tremendous convulsion in 1792.

TAC'AMAHAC or **TAC'AMAHAC'A** is a name of Indian origin, now confusedly applied to four different resins: as to that of the Poon-wood tree of India (*Calophyllum inophyllum*), *Icica tacamahaca* of South America, the Tacamahac poplar (*Populus balsamifera*) of the United States, and *Elaphrium tomentosum* of South America. They are chiefly used as varnishes.

TACCA'CEÆ is a small tropical order of monocotyledonous plants belonging to the series Epigynæ, containing only two genera, Tacca and Ataccia. The species are large perennial herbs with tuberous roots and large radical, entire, or divided leaves. The flowers are greenish or brown, produced in an umbel on the top of a long leafless stalk, and surrounded by an involucre of simple bracts. The perianth is petaloid, epigynous, six-cleft; the stamens are six, with petaloid filaments, and the ovary is one-celled. The fruit is a berry. The species are few in number, and are found in the tropical parts of the world. The members of this family are possessed of acridity both in their tubers and in their herbaceous parts, but the roots lose some of this quality by culture, at the same time that they become larger. Those of *Tacca pinnatifida*, the best-known species, and a native of the Malayan Peninsula, the Moluccas, Madagascar, and Australia, are roundish, red, the size of a man's fist, and extremely bitter. The tubers of this plant are rasped and macerated for four or five days in water; a white highly nutritious fecula, like arrowroot, is then separated, and, like sago, is employed as an article of diet by the inhabitants of the Malayan Peninsula and the Moluccas. It is said to be useful in cases of dysentery. The leaf-stalks are used by the Society Islanders in the manufacture of a white shining straw, which they plait into hats, &c.

TAC'ITUS, CAIUS CORNE'LIUS, was probably born in the reign of Nero, but neither the place of his birth nor the exact date is known, nor is anything known of his parentage. The few facts of his life are chiefly collected from his own works, and from the letters of his friend, the younger Pliny. He was about the same age as Pliny, who was born about A.D. 61, but the elder of the two.

Tacitus states that he owed his first promotion to Vespasian, and that he was indebted for other favours to that emperor's sons and successors, Titus and Domitian. In A.D. 77 C. Julius Agricola, then consul, betrothed to him his daughter, and the marriage took place in the following year. In the reign of Domitian, Tacitus assisted as one of the Quindecemviri at the celebration of the Ludi Seculares, which event took place in the fourteenth consulship of Domitian (88). At that time he was also prætor. He was not at Rome when his father-in-law Agricola died there (93), in the reign of Domitian. On the death of T. Verginius Rufus, in the reign of Nerva (97), he was appointed consul suffectus.

He is described by his friend Pliny as one of the most eloquent orators of his age. It is not known when he died, nor whether he left any children. The Emperor Tacitus claimed the honour of being descended from him, but we have no means of judging of the accuracy of the pedigree.

His extant works are—the "Life of Agricola," the "Treatise on the Germans" ("De Moribus et Populis Germaniæ"), "Histories," "Annals," and the "Dialogue on Orators, or the Causes of the Decline of Eloquence." None of his orations are preserved. The "Histories" comprehended the period from the accession of Galba to the death of Domitian. There are only extant the first four books and a part of the fifth, which comprised little more than the events of one year. The fifth book contains the commencement of the story of the siege of Jerusalem by Titus. The "Annals" included the history of Rome from the death of Augustus to the death of Nero, a period of fifty-two years. A part of the fifth book is lost; the seventh, eighth, ninth, tenth, the beginning of the eleventh, and the end of the sixteenth and last book, are also missing

These historical works are characterized by an elevation of thought which had its foundation in the moral dignity of the writer and the consciousness of having proposed to himself a noble object. He was a profound observer of character; it was his study to watch the slightest indications in human conduct, and by interpreting these outward signs, to strive to penetrate into the hidden recesses of the heart. His power of depicting secret thoughts as unconsciously becoming the springs of a man's actions, has perhaps never been equalled by any other historian. He lived through a time when the value of philosophy had to be tested by its practical application, and his historical studies carried him through a period in which the mass were sunk in sensuality, and the really good and great had no consolation but in the consciousness of their own thoughts. Though he appears to belong to no sect of philosophers, his practical morality was of the Stoic school, the only school which in those degenerate times could sustain the sinking spirits of the Romans, and which even under favourable circumstances guided the conduct of the wise Aurelius. His religious opinions partook of the character of his age; he had no strong convictions, no settled belief of a moral government of the world; his love of virtue and abhorrence of vice were purely moral; they had no reference to a future existence. In one of his earliest productions he hopes rather than expects that the souls of the departed may still live and be conscious of what is passing on earth. But in his latest writings there are no traces that his hopes or his wishes had ripened into a belief.

The style of Tacitus, especially in his "Annals," is the apt expression of his thought—concise, vigorous, and dramatic. He has perhaps attained as great a degree of condensation as is compatible with perspicuity; sometimes his meaning is obscured by his labour to be brief. His histories are admirable works of art, constructed on a fixed

principle, and elaborated in obedience to it. He loves to display his rhetorical skill, but he subdues it to his dramatic purpose. It is a fault that his art is too apparent, that his thoughts are sometimes imperfectly or obscurely expressed, that he affects an air of mystery, that his reflections on events are often an inseparable part of them, and consequently the impressions which it is his object to produce can only be rectified by the rigorous scrutiny of a matured mind. After these expressions it is hardly necessary to say that Tacitus must not receive implicit faith for his famous portrait of the Cæsars, drawn with flashes of lurid light upon a background of darkness, designed to throw the central figure into unreal prominence. Did Tacitus deliberately sit down to write his misrepresentations of those unlucky princes? Probably he found a number of perversely chosen or malignantly invented stories in his authorities, to which, by a kind of colligation of facts, he supplied a hero in his Tiberius or Claudius. He thought out what manner of man it must be of whom these things were told, then drew him, and his genius has got the impressive fiction accepted. Neither of these theories will quite account for everything that he says, or for everything that he tells, of the emperors. But whatever the truth may be, no one should be allowed to read the "Annals" without a general warning or a running comment upon improbabilities.

The first printed edition of Tacitus, which is extremely rare, was issued at Venice in 1470, by Vindelin de Spira; this edition contains only the last six books of the "Annals," the "Histories," the "Germany," and the "Dialogue." Later editions of Tacitus are very numerous. One of the best is that of Ernesti, by Oberlin (Leipzig, 1801, two vols. 8vo); it contains the valuable notes and excursus of Lipsius, the best of all the commentators on Tacitus, and in his department one of the first of modern scholars. There is an edition by Immanuel Bekker (Leipzig, 1831, two vols. 8vo), and a "Lexicon Taciteum," by Bötticher (Berlin, 1830, 8vo). There are translations of Tacitus in Danish, Swedish, Dutch, German, French, Italian, Spanish, Portuguese, and English. The Italian version of Davanzati is considered to be a model of condensed and vigorous translation. D'Alembert translated into French various passages from Tacitus. The English version of Murphy, which appeared in 1793, is diffuse and feeble.

TAC'ITUS, MARCUS CLAUDIUS, a Roman Emperor, was the successor of Aurelian. After the interregnum of nearly seven months which followed the death of that prince, Tacitus, then princeps senatus, was chosen unanimously, at the advanced age of seventy-five. The army confirmed the act of the Senate, and he commenced his reign in September, 275, with the most favourable assurances from all classes of his subjects. He immediately instituted some salutary reforms relating to the coinage and other matters, and set an example of temperance, justice, and moderation.

The Scythæ, or Goths, made an irruption at this time from the Palus Mæotis into Pontus and Cappadocia. Tacitus proceeded thither in person with his brother Florianus, and compelled them to retire by force of arms. But he had appointed as governor of Syria Maximin who treated his subjects with so much cruelty that the magistrates of the towns in that province conspired against and killed him. Despair of pardon led them to form designs against the life of the emperor, who fell a victim to their treason at Tyana, in Cappadocia, after a reign of about eight months, in the spring of the year 276.

TACK (Ital. *attacare*, from Gr. *tassô*), in naval technics, the corner or weather clue of a course, as also of any sail set with a bottom or gaff, and of a flag. The same term is applied to the rope by which the clue is stretched; as, for instance, the *main tack* is the rope which draws down the weather clue of the mainsail to the vessel's side.

When a ship is close-hauled, with the wind on the starboard side, she is said to be on the starboard tack; and she is on the port tack when the wind is on the port or larboard side.

To tack is to change from one quarter to another, as from port to starboard, by bringing the ship's head to the wind, and shifting the tacks of the sails according to the direction the ship is intended to take.

TAC'NA, a town of Peru, in a province of the same name, situated in a fertile spot, distant 55 miles north of its port of Arica, with which it is connected by railway. It is subject to terrible earthquakes. Population 12,000.

TACSO'NIA is a genus of ornamental shrubby climbing plants of the order PASSIFLOREÆ, resembling the PASSION-FLOWER (Passiflora), and possessing the same structure of pistil, stamens, and fruit, but differing in the great length of the cylindrical tube of the calyx, which is furnished with a crown at its throat and another near its base. Its botanical appellation is derived from its Peruvian name, Tacso. All the species are natives of tropical America and the West Indies, and the fruits of several are eaten by the natives. The plants are handsome, and are cultivated in English hothouses.

TACT is that intuitive, or at least inexplicable nicety of judgment in delicate negotiations which some persons have, and which is to mental decisions what habit is to actions. The persons of greatest tact can never explain the reasons which led them to their decisions, often involving the most delicate or subtle differences from ordinary actions, though, after the fact they are fully able and ready to justify what they have done. If a man were to pause in a conversation and cast about for means of turning it away from an unsafe point, he would assuredly betray himself by his very anxiety; but the man of tact would accomplish the matter without consciously thinking of it at all. The word is very happily fitted to the quality, for it is a fineness of mental *touch*, and a quickness to perceive, and in the true sense of that much-abused word, to sympathize with, the attitude of an opponent, that tact greatly consists. Curiously enough, the unfortunate persons who have none of this priceless mental possession are invariably ignorant of their deficiency, and calmly exasperate where they should soothe, charging their failure upon the over-sensitiveness of their antagonist.

TACTICS, MILITARY, properly signifies the art of forming the troops of an army in order of battle, and of making changes in the dispositions of them as circumstances may require, the difference between tactics and strategy being that the former has to do with the actual battlefield, while the latter has reference to the whole campaign and the preparatory arrangements for engaging the enemy.

The earliest records of battles are principally accounts of the prowess of individual chiefs, and they seem to have consisted for the main part of individual combats; but with the increase of civilization and the gathering of men into larger communities, the influence of discipline and the power of united action were speedily recognized. In the books of the Old Testament the earliest battles described appear to have been conflicts between irregularly armed and undisciplined mobs, but in the later accounts we may perceive allusions to organization, drill, discipline, and the employment of tactics on the part of the armies engaged. The Greek and Roman generals, who raised the military art to a high degree of perfection, studied carefully both strategy and tactics, and notices of their most celebrated formations for fighting purposes will be found under LEGION and PHALANX. In the early part of the mediæval period the chief reliance of every commander was placed upon his mailed and mounted knights, the partially armed and untrained footmen, who made up the bulk of the army, being considered of much less value on the field of battle. At a later period, the archers, armed with the long or cross-

bow, proved themselves to be dangerous opponents to the armoured knights, while the introduction of gunpowder effected a complete revolution in the art of warfare. During the seventeenth and eighteenth centuries the troops engaged were arranged with a good deal of elaboration on the field of battle, and two opposing armies would proceed leisurely, neither attacking till the other had made its dispositions. The respective commanders were like two chess players arranging their pieces in the regular order before the commencement of a game, and when infantry, cavalry, and artillery were arranged with all the nicety of a field day, the affray opened. The short range of guns and muskets enabled a looker on to observe the fight with comparative safety from some advantageous position: hence every officer and every man had his prescribed position and duty, from which he dared not deviate, the whole of the tactics being in the hands of the commander-in-chief, who controlled and guided every move of the living machine.

The armies of the French Revolution, imbued with the feeling that all ideas previous to their own were to be abandoned as antiquated, were the first to become careless of the definite and solid formations with which Blenheim and the victories of the great Frederick were won; but Napoleon restored a good deal of the old order, though he introduced many important improvements of his own. Tactics were described by Napoleon as "the art of being stronger," and his whole talent was strained by endless manœuvre and evolution to march always on the enemy at an angle, and destroy his forces in detail. During the long peace which followed the close of the Napoleonic wars, but little alteration was made in military tactics, and those of the Crimean War were in many respects much the same as those employed by the Duke of Marlborough 150 years before.

Since that period, however, the range both of artillery and small arms, and the rapidity of their fire have been enormously increased, and military tactics have undergone the most extensive alteration in consequence. Instead of the old stiffness and solidity, formerly so highly prized, it is now the aim of each commander to train his men to act in extended order, the officers adapting their movements to the exigencies of the moment, and the men being required to enter intelligently into all the necessary manœuvres. It follows that modern tactics require the very highest training and discipline that a soldier can possibly have, seeing that they involve that which is most trying to the nerves of a soldier—apparent isolation, disorder, and confusion. The great battles of 1870-71 between the forces of France and Germany frequently saw whole battalions, regiments, and brigades broken up into clouds of skirmishers; it was impossible to prevent the mixture of different bodies, for the men were bound to take advantage of every foot of cover, and wound through little hollows, or gathered behind hillocks, m[illegible]ng, rushes as best they could, and in all this inevitably getting separated from their own company.

The pages of a popular work are scarcely suitable for discussing the various principles of attack and defence pursued by an army in the field. It may, however, enable some of the tactics there employed, especially those of flank attacks, to be better understood if we say that when an army in position on level ground is to be attacked on one of its wings, the army acting against it is usually placed *en echelon*, and a favourable moment is then chosen for deploying the greatest mass of infantry against the wing. An army thus attacked, on finding itself in danger of being turned, may endeavour to prevent the success of the manœuvre by throwing back that wing into a line parallel to that of the attacking corps; this is called forming the army *en potence*. It is evident that the attacking troops cannot now turn the flank without making a circuitous movement, by which they may become separated from the rest of their line; and if the army is strong enough it may form a line parallel to the direction of the wing thrown back. By such a movement the parallel order would be restored, and the other wing might even be made to turn the opposite wing of the enemy; this should of course be attempted, as the return to a parallel order of battle leads to no useful result.

Hitherto we have spoken chiefly of what must always be a general's main dependence, the tactics of infantry. The part played by cavalry and artillery, however, is no less important; in fact, Napoleon III., on surrendering himself to his brother monarch at Sedan, observed that the German successes were principally due to their artillery. A battle, as a rule, is opened with an artillery contest; and guns should therefore be kept near the front, being liable at short notice to have to prepare an attack for infantry. On finding the enemy, guns are pushed well forward, and open fire from positions which give them good command of their adversary, and from which, having effected the necessary preparation, they can also support the infantry when that is called to advance. The attacking artillery first directs its fire on the enemy's guns, trying to silence them, or at least cripple and reduce their fire. If successful the guns are then mainly turned on the enemy's infantry to shake and demoralize them, and so prepare the way for an infantry attack. It may be that the artillery would have some hours' work to do before the infantry is ready to engage, and besides harassing the enemy it would thus be covering the deployment of troops who have come up in columns. The part played by artillery is becoming constantly more important, and very high tactical training is now given to this branch of the service at Woolwich.

The same principles as are adopted in the practice of infantry and artillery prevail in cavalry drill and tactics. The greatest responsibility is laid upon individuals, and an intelligent appreciation of the spirit rather than the letter of their instructions is demanded from them. In war one regiment is now attached to each division of infantry for advanced guards, outpost duties, patrols, and orderlies. The rest are formed into cavalry divisions, each of which, with its two batteries of horse artillery, is able to act with entire independence. The first duty imposed upon this force is to rush to the frontier and veil the formation and movements of the infantry corps, while bringing information concerning the movements of the enemy. The second duty of the cavalry divisions, as distinguished from the regiments accompanying the infantry, is to cover and clear the whole country for a full day's march, if possible, in front of the infantry, thereby saving the marching regiments from the toilsome duty of outposts, and by affording to the infantry a period of secure and most necessary rest, contributing remarkably to the marching power of the whole army. As the corps close with the enemy the cavalry divisions fall back into reserve, or protect the flanks, or maintain communication between corps necessarily separated. On the day of battle it is recognized that cavalry cannot attack infantry without very severe loss, but even this duty is assigned to them if it be necessary to hold the enemy fast until the more slowly-moving foot regiments have time to arrive. The skirmishing tactics we have described are peculiarly open to cavalry attacks, and the very knowledge that cavalry are on the field is to be under their influence, the swiftness of their movements being such that they may appear at any moment where least expected. The most famous action of cavalry as a mass in modern times occurred at the battle of Mars la Tour, on the 16th August, 1870, when the cavalry of the 3rd Prussian Corps, at a fearful sacrifice, charged and held back the whole army of Bazaine till the arrival of supports to their well-nigh exhausted corps. The whole successes of the Germans in that war

were indeed due largely to the splendid efficiency of the cavalry in constantly feeling the enemy, penetrating for this purpose sometimes as much as 50 miles in front of the main army, and keeping Von Moltke much better apprised of every movement of the French than were the French chief commanders themselves. Such tactics were the result of superior aggressive boldness and determination, and in any future campaign in which the combatants are fairly well matched, would probably be rendered more difficult by the adoption of similar tactics on the part of an active enemy. The war between Russia and Turkey in 1877–78, which was the next campaign witnessed in Europe, was one in which a power notorious for its deficiency in cavalry was matched against one, in this respect, the most amply provided in the world. Cossacks accompany a Russian army in swarms; but with the exception of one or two dashing raids, like that of Gourko's through the Balkans, they accomplished nothing worth mention in 1877–78. In fact, their inactivity and want of intelligence was the main cause of several serious difficulties of the Russians—such, for instance, as the march of Osman Pasha to Plevna and the occupation of that place by the Turks.

The conflict which afterwards ensued around Plevna strikingly illustrated the value of the spade as auxiliary to the firearm. That Plevna was impregnable was due to Turkish spades as much as to Ottoman valour; and so clearly was this understood by Skobelev and other Russian generals that they issued the spades they found there to their men, who, with a dearly bought appreciation of their value, carried them cheerfully through the awful snow-drifts of the Balkans and during the fighting in Roumelia, never laying them down until the treaty of San Stefano was signed. The same principle, of throwing up rough and ready entrenchments, enabled a mere handful of British troops to hold out during a whole night against the onslaught of thousands of Zulus at Rorke's Drift in 1879.

After the Russo-Turkish War of 1877–78 much greater importance was attached by military authorities to the use of the spade. Russians and Austrians now carry one to every two men; besides picks and reserve spades in waggons, a spade is carried behind every four men in the German army; in many parts of the French army every soldier carries his own entrenching tool; while, in the British service, all are carried in waggons or on pack animals—to be out of reach, it is to be feared, when most wanted. If, however, the soldier is drilled continually to throw up cover, he should be quite as assiduously trained to leave it and push forward on every possible occasion. The experience of the Crimea was, that men who passed long days and nights hiding behind earthworks, became ill-suited for forward fighting in the open.

Since the great conflicts of 1871–72 and 1877–78 the range of artillery has been considerably increased, machine guns have been invented possessing enormous rapidity of fire, and still more recently the magazine rifle has taken the place of the simple breechloader, alterations in armament which will of necessity require alterations in tactics, the extent of which can hardly be estimated at present.

TACTICS, NAVAL, may be briefly defined as the art of bringing ships of war into action, and of handling them during an engagement. In a larger sense the term would include the defence of coast-lines, harbours, &c., and the protection of or attack upon the commercial marine.

In early times, when the ships of the Phœnicians, Egyptians, Greeks, or Romans engaged in conflict upon the comparatively smooth waters of the Mediterranean, the aim of each commander was if possible to ram the ships of his enemy, or failing this, to destroy their crew by means of volleys of stones from the balistæ and showers of arrows. At a later period when ramming failed the ships were run alongside each other, fastened with grappling hooks, and the crews fought hand to hand after the same fashion as soldiers engaged upon land. Now and again some novel experiment would be tried, as when one commander used earthenware jars filled with poisonous snakes for throwing upon the decks of the enemy, or another who had gained the weather gauge endeavoured to blind the crews of the enemy by means of showers of lime, but for the most part grappling and boarding were the chief tactics employed in naval engagements. During a great portion of the mediæval period the galley of the ancients continued to be the favourite type of the ships of war, but the introduction of gunpowder and the greater reliance upon the wind as a means of propulsion necessitated a change in the methods of conducting maritime warfare. With the galleys, which were propelled by oars, and whose guns were mounted in the bows, the order of battle was if possible crescent-shaped; but as the sailing ships with broadside armament came into use, the formation of "line ahead" was adopted so as to present the broadside to the enemy. The great object in manœuvring was to obtain a position to the windward of the enemy, and in the English navy during the eighteenth century the greatest importance was attached to the obtaining of this advantage. Towards the close of this century, after the appearance of the famous "Essay on Naval Tactics" by John Clerk of Eldin, some improved tactical manœuvres were adopted by the British admirals, and these contributed greatly towards the naval victories obtained over the French during the revolutionary wars. The introduction of steam and the improvement of naval ordnance which marked the middle of the present century effected a revolution in naval tactics, while the rapid changes in the construction of ships of war has kept them in a state of transition ever since. The American War demonstrated the necessity for constructing ironclads in the place of the old wooden ships of war, while the development of the torpedo introduced a new and serious danger to vessels employed in coast attacks. The great naval battle fought off Lissa, in July, 1866, showed that the ram, where it could be used, was the most formidable weapon of a modern ship of war, but it added but little to the science of naval tactics, and in the subsequent wars between France and Germany, and Turkey and Russia, the disparity in the naval strength of the contending nations was such as to prevent any important maritime engagement. The offensive and defensive powers of modern ships of war far transcend anything hitherto conceived in the history of the world. but the naval officers of to-day are of necessity very much in the dark as to their practical efficacy in actual warfare. Enormous guns are now mounted capable of hurling huge shells through any armour yet constructed, but it is not easy to estimate the chances of their being able to exert their full powers when firing from a moving platform at a rapidly moving target. Rams of the most formidable size now form part of every important ship of war, but under many conceivable circumstances the act of ramming might be almost as dangerous to the attacking vessel as to that sustaining the attack. All vessels of the largest size are now provided with one or two swift torpedo launches, but they also carry numerous machine guns as a defence against torpedo boats, and experience only can show whether attack or defence possesses the advantage. The power of coast forts, especially when aided by locomotive and fixed torpedos, appears, when considered alone, to be overwhelming, but on the other hand a modern ironclad presenting her bow to the enemy offers but a small mark to ordnance; torpedoes have a very limited range of destructive power, and shells might be flung by naval guns into a port from a distance at which the vessel mounting them would be almost invisible to gunners on shore. Concerning these and a host of other problems practical men are widely at variance, and the first war waged between important naval powers, when such an event unhappily occurs, may not improbably neces-

sitate a revolution in naval construction and tactics as great as any we have referred to in this notice. See also under NAVY, SUBMARINE NAVIGATION, and TORPEDO.

TAC'TUAL PERCEP'TION. See TOUCH.

TAD'POLE. See FROG.

TAD'POLE HAKE (*Raniceps trifurcus*) is a species of fish belonging to the family of cod-fishes (GADIDÆ). This fish is not uncommon on the coasts of Northern Europe, and is occasionally brought to market with sprats. The body is dark brown in colour and covered with small scales, and the head is large, broad, and depressed. There are two dorsal fins, of which the first is very short and rudimentary. The tadpole hake seldom exceeds 12 inches in length. It is a wandering, solitary fish, and is seldom taken. It feeds on star-fishes, molluscs, and crustaceans.

TA'EL, a Chinese money of account, worth about 5*s.* 10*d.* sterling. It is also a weight, and equivalent to 580 grains avoirdupois; 580 grains of Sycee silver makes the tael of account, and exchanges at 720 taels=1000 Mexican dollars. The coins which should be worth 5*s.* $11\frac{3}{4}$*d.* by this are really never worth more than 5*s.* 10*d.* owing to their worn condition. The tael is divided into 10 mace and 100 candareens. In Japan the tael is being rapidly displaced by the sen and yen, worth ·42*d.* and 3*s.* 6*d.* respectively.

TAFF, a river of South Wales, rising under the Brecknock Beacons, and flowing through Glamorganshire into the estuary of the Severn at Cardiff. It has a course, S.S.E., of about 40 miles, through the heart of the South Wales iron and coal field.

TAF'ILET or **TAFILELT**, a division of Morocco, consisting of the oasis of the same name, lying south east of the Atlas Mountains, between 30° 45′ and 31° 10′ N. lat. and 3° 3′ and 3° 25′ W. lon.; population estimated at 100,000. The oasis of Tissimi lies north of it, and that of Sahra north-east. Tafilet is a fertile plain watered by two rivers, both of which are lost in the sands of the desert. Rain seldom falls. Wheat and barley are cultivated on the banks of the rivers, but dates are the chief product. Large herds of sheep and goats are kept, and stuffs and carpets are manufactured. There are mines of lead and antimony. The oasis is divided into five districts, Sfalet, Rhorfa, Ifili, Shiffa, and Tannajint. The most important town is Abuam, about 210 miles E.S.E. of Morocco, but the official centre is Rissani, a few miles north-east of Abuam. The inhabitants are mostly Shelloohs. A considerable trade is carried on with other parts of Morocco and with Algeria. Tafilet, which is mentioned by the earliest Arab chroniclers, is probably identical with the kingdom of which Sigilmessa, founded A.D. 759, was the capital. In 1648 a king of Tafilet founded the dynasty which still rules Morocco.

TAG'ANROG, a town of European Russia, in the government of Ekaterinoslav, stands on a high promontory near the north-eastern extremity of the Sea of Azov, and has 63,025 inhabitants, who are chiefly Greeks. The town is most advantageously situated for commerce; but the harbour is shallow. A mole was built in 1872, and has proved of much advantage to the coasting craft, but can never become of service to shipping, the depth of water in the offing not permitting of the approach of large vessels. It is the chief place for all the intercourse between the provinces on the Donetz and the Don and foreign countries; goods are also brought by land-carriage from the Volga at no great expense; and by the Voronege-Rostoff Railway, upwards of 350 miles in length, there is communication with all the main lines of the empire. The streets are lighted with gas, and works have been constructed for supplying the town with water from the river Micuse, about 9 miles distant. The exports are corn, iron and iron ore, mast and building timber, hemp, pitch, and tar, copper, potash, saltpetre, rape, and linseed, wool, leather, caviare, and fish. The only articles of note imported are the products of Turkey and the Levant, the chief being olive oil, dried fruits, and Greek wines. The navigation at Taganrog is closed by the frost from December to March; but the masses of ice swept into the strait of Yenikali or Kertch frequently retard the ship communication between the Black Sea and the Sea of Azov for a month later. The town is pretty well built; it is fortified, and has a gymnasium, cathedral, several churches, dockyards, large and numerous warehouses, and many very handsome private dwellings. The climate of Taganrog is temperate and remarkably healthy, and the surrounding country is very fertile. Taganrog owes its existence to Peter the Great, who built a fortress here in 1706, which was, however, demolished, according to the convention of the Pruth, in 1711. The fortifications were rebuilt, and the harbour enlarged, by Catharine II., about 1768, but they were again destroyed by a bombardment of the gunboats of the allied Anglo-French fleet, 3rd to 6th June, 1855.

TAGL'IA, an Italian term given to a system of fixed pulleys collected in one common block, and also of a system of movable pulleys collected in a separate block. To the latter the weight is attached, with one string going round all the pulleys, and having one end fixed to a point in the system, and the other end going from one of the fixed pulleys drawn by the power. When two or more taglias are combined, so that one shall act upon the other, the system is called a *compound taglia.*

TA'GOS, a leader or general in ancient Greece: especially applied to the commander-in-chief of the Thessalians.

TAGUAN. See FLYING SQUIRREL.

TA'GUS, called by the Spaniards *Tajo*, and by the Portuguese *Tejo*, the largest river of the Spanish Peninsula, rises at the junction of the Sierra de Albaracin with the Sierra de Molina, on the confines of Aragon and Castilla la Nueva, 45 miles north-east of Cuenca, and flowing in a general direction of west by south, drains the great plain, partly in Spain and partly in Portugal, which is inclosed by the sierras of Castilla la Vieja, the Sierra de Gata, and the Sierra de Estrella on the north, and by the Sierra de Molina, the mountains of Toledo, the Sierra de Guadaloupe, and the highlands of Evora on the south. Its total length is about 510 miles.

With the exception of the plains of Aranjuez and Talavera the scenery is dreary and mean in the extreme. In summer the stream, though always rapid, diminishes in depth so as to be fordable at several points, even as far down as Santarem.

The navigation begins at Villavelha, 18 miles within the Portuguese border and 115 from the river's mouth, but it is interrupted by rapids as far as Punhete, opposite the junction of the Zezere; from here to the sea large barges ply, and small ships ascend with the tide as high as Santarem. At its entrance into Portugal the Tagus has a width of 64 yards; at Punhete it is 160 yards wide; below Salvaterra it resembles a gulf more than a river, being about 5 miles broad. Opposite the mole at Lisbon the width narrows to little over a mile, and so continues to the Castle of San Juliao. At this fort a bar or bank divides the river into two channels, of which the northern is rather dangerous, but the southern, nearly 900 yards wide and 47 feet deep, is safe, and has a good bottom.

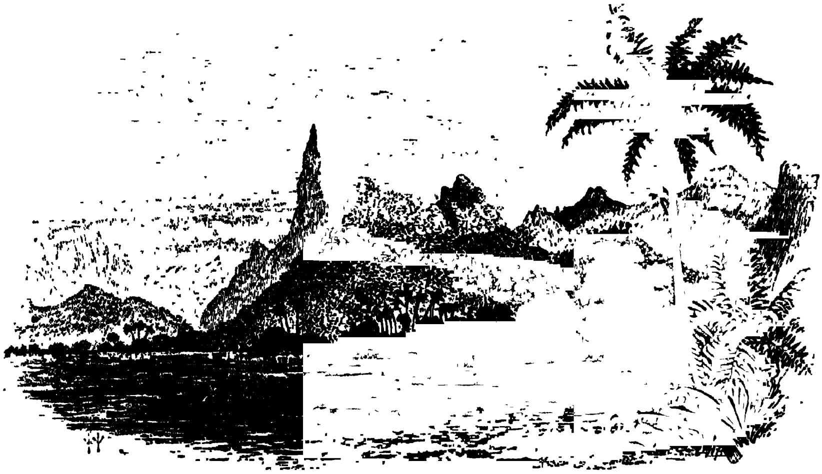
TAHI'TI or **OTAHEITE** is the largest of the Society Islands, a considerable group situated in the Pacific Ocean between 16° and 18° S. lat., and 148° and 153° W. lon. Tahiti is about 45 miles long and more than 130 miles in circumference. It consists of two peninsulas of unequal extent, united by a low isthmus somewhat more than 3 miles wide, which is submerged at high water. The north-western and larger peninsula is called Opureone or Tahitinue (Great Tahiti), and the south-eastern Tiarrabooa or

Tahiti-iti (Little Tahiti). The island is surrounded at a distance of from 3 to 6 miles by a coral reef, which has several breaks, and affords many good anchorages. The interior of both peninsulas is occupied with mountain masses, which terminate in high and sharp peaks. The most elevated of these peaks, called Opureone, rises to between 7000 and 8000 feet above the sea-level. There are many fertile valleys, and a belt of rich land around the coast.

The climate is very mild and generally healthy. The productions are numerous, especially the plants which supply food for man. Bread-fruit, yams, plantains, arrowroot, cocoa-nuts, oranges, and limes grow spontaneously; and the sugar-cane, cotton, coffee, maize, tobacco, fruits, and vegetables are cultivated in small quantities. Food, cloth, oil, and cordage are obtained by the natives from various plants. Timber is abundant. English domestic animals have been introduced. Horses are numerous.

Tahiti was discovered in 1606 by the Spaniard Quiros. It was afterwards visited by Wallis, Bougainville, and Cook. Missionaries made a settlement on the island in 1797; and during half a century they have done much to civilize the natives, who are of the Malay race. They have mostly been converted to Christianity. The population of the island is about 14,000.

Tahiti was taken possession of by the French in 1846, and they exercised a protectorate over it until 1881, when



Island of Tahiti.

it was formally annexed to the French republic. The principal town and port is Papiete, on the north-west.

TAILLE, an old French name for the tenor voice and the tenor violin or viola, not often now seen. But the modification, basse taille, used for a low tenor, *i.e* a barytone, is in common use.

TAILOR-BIRD (*Orthotomus sutorius*) is a species of Passerine birds belonging to the family Timeliidæ, so called from the singular mode in which the nest is constructed. The tailor-bird is a native of India and China, and is common in wooded districts, haunting gardens, orchards, &c., where it is usually seen in pairs. The nest is formed of one or several leaves, which are sewn together by the bird, frequently in the shape of an irregular inverted cone, inside which is placed a deep cup of fine cotton, wool, flax, and a few hairs. The material used for sewing the leaves together consists generally of cobwebs, but cotton, the silk from cocoons, and vegetable fibres are also used. The number of leaves used for the outside of the nest varies according to their size and description. The eggs are from three to four in number, and vary in colour, the ground-colour being either bluish-green or white, with reddish-brown spots. The male measures 6½ inches in length, and has a long graduated tail measuring 3½ inches. The female is destitute of the elongated tail-feathers. The general colour is olive, greenish above, the head being reddish-brown, the wings brown edged with green, and the tail light brown; the under surface is white. The tailor-bird is a familiar bird, being frequently seen near houses. It feeds on insects, such as ants and larvæ, which it takes on the ground as well as among the leaves of trees.

TAIN, a royal burgh of Scotland, in the county of Ross and Cromarty, and a station on the Highland and Sutherland Railway, is situated on the shore of Dornoch Frith, near the mouth of the river Tain, about 23 miles N.N.E. from Dingwall, and 638 from London. The town stands on a ridge or terrace overlooking a low plain, which extends from the foot of the terrace to the shore, a quarter of a mile distant. It is irregularly built, but has been much improved.

Tain is Scandinavian, meaning "place of assembly," but the Gaelic name is Baile Dhuthaich or the "town of St. Duthus," and a chapel where the saint was born existed in old times, and as a sanctuary was the scene of many historical events. It was burnt in the fifteenth century, and its grounds are now laid out as a cemetery. An old church, founded in the sixteenth century, was restored in 1882, and set apart as a resting-place for the great men of Ross-shire. There are also a parish church, Free, U.P., and Episcopal churches, a fine court-house, a public hall, and an academy. The population of the police borough in 1881 was 1742; of the parish, 3009.

TAIT, ARCHIBALD CAMPBELL, D.D., Archbishop of Canterbury, was the son of Mr. Crawford Tait, a Scottish lawyer of Harviestoun, Clackmannan, his mother Susan being fourth daughter of Sir Islay Campbell, sometime Lord President of Session. He was born in Edinburgh, 22nd December, 1811, and received his first instruction in the High School, and afterwards in the academy of that city. He was next sent to the University of Glasgow, from which he went at the age of nineteen years as an exhibitioner to Balliol College, Oxford. In 1833 he took his degree of B.A. with first class honours, and shortly afterwards was elected to a fellowship at Balliol, in due time becoming tutor and dean, and taking his M.A. degree in 1836. His reputation as a tutor of his college was already considerable when his appearance in 1841 as one of the "Four Tutors" who protested against

the celebrated "Tract No. 90" of Dr. Newman, first made his name known to the outside world. The following year he succeeded Dr. Arnold as headmaster of Rugby, where he not only carried forward the beneficial changes introduced by his predecessor, but greatly enlarged the curriculum of the school—among other things extending the study of mathematics, and making natural history a portion of the course. In 1850, after a sojourn at Rugby of nearly eight years, he accepted from the government of Lord John Russell the deanery of Carlisle, where he remained six years, during which period he took an active part in the proceedings of the first Oxford University Commission, the labours of which almost transformed the condition of Oxford. In 1856 on the resignation of Dr. Blomfield, he was appointed by Lord Palmerston to the see of London, and during the next twelve years he laboured with unceasing diligence to sustain the onerous duties of this important position. One of the most noteworthy of his achievements during this period was the commencement of a large annual subscription called the Bishop of London's Fund, for the erection of churches, schools, and parsonages in the poorer suburbs of the metropolis. In 1868, on the death of Archbishop Langley, he was appointed by Mr. Disraeli to the see of Canterbury, a position which he retained until his death, 3rd December, 1882. Dr. Tait married in 1843 Catharine Spooner, daughter of Archdeacon Spooner, the union being one of singular happiness, though it was marked by the severest trials. Memorials of Mrs. Tait, of the only son, with an account of the death of five young daughters, who died within six weeks of scarlet fever in the spring of 1856, are to be found in the volume entitled "Catharine and Crawford Tait," published in 1878.

Archbishop Tait was a man of genial and lofty character, to which was united a keen and cultivated intellect. He was untiring in good works, comprehensive in charity, tolerant in opinion, and as Primate he laboured with all his powers to make the Anglican Church in the best sense of the term a truly national church, and to enlist more fully in its behalf the intellect and affection of the country.

TAI-WAN-FOO, the capital of FORMOSA, is a considerable town, situated on a large alluvial plain on the south-west coast, and has a wall built in 1725. The streets are straight, and intersect one another at right angles: they are full of shops, which are abundantly provided with all articles of Chinese industry. Inside the wall, which is 6 miles in extent, are many open spaces with fine trees. The commerce of the port was once considerable, and the town was the seat of a Dutch factory; but owing to the silting up of the harbour the trade has almost entirely departed, no vessel of any burden being able to reach the town. The population is estimated at 70,000. The sugar grown in the neighbourhood is refined here in large quantities. The port, such as it is, was opened to foreign commerce in 1858.

TA-KU is the name of a village and of some forts in China, situated at the entrance of the Pei-ho River, in the Gulf of Pe-che-lee, which forms the roadstead for large vessels trading to Tien-tsin. The forts were captured by the British and French allies in 1860, and held by English troops until 1862, when they were evacuated.

TALAPOIN' (*Cercopithecus talapoin*) is a species of monkey belonging to the genus Cercopithecus (GUENON). This species has been separated as a distinct genus, on account of the large development of its brain, the shortness of its muzzle, and especially the small size of its hinder molars, of which those of the lower jaw have only three tubercles.

The talapoin is the smallest of the monkeys of the Old World. Its fur is of a greenish tint, with the lower surface of the body and the inside of the limbs grayish-white; the hairs of the forehead are raised, so as to form a sort of tuft; the whiskers are yellowish, and the face flesh-coloured, with the nose and the large ears dark brown or black. It is a native of the West Coast of Africa, but is less commonly brought to Europe than many other species inhabiting the same locality, although its gentleness and intelligence render it one of the most interesting of the Old World monkeys. In captivity it is very lively and amusing.

TALAR'IA, the foot-wings of the god Hermês (Lat. Mercurius), which are represented in some statues as growing from the ankle-bone, but in most as growing out of the sandal straps.

TALAVE'RA DE LA REYNA (ancient *Talabriga*), a town of Spain, in the province of Toledo, on the Tagus, 64 miles south-west of Madrid, with about 9000 inhabitants. It is a place of great antiquity, and was the scene of many conflicts between the Moors and Christians. On 27th and 28th July, 1809, a battle was fought in the immediate vicinity, between the French, under Victor, Jourdan, and Sebastiani, and the British, under Sir Arthur Wellesley. In the decisive contest of the 28th, 30,000 French were driven back by 16,000 British troops.

TAL'BOT is a variety of hound. The bloodhound was probably the talbot of the sportsmen of olden time, though that name appears to have been afterwards applied to a breed, now extinct, pure white in colour, with a large head, very broad muzzle, and long pendulous ears. It appears to have been kept rather for show than for sporting purposes.

TALC, a soft mineral of white, gray, or pale green colour and pearly lustre, occurring ordinarily in foliated or flaky masses. It has a greasy feel, and is almost translucent, and the thin laminæ are flexible, but not elastic. In chemical composition it is a slightly hydrated silicate of magnesia, and occurs most commonly associated with SERPENTINE and DOLOMITE. A finely granular variety is known in commerce under the name of *French chalk*, and ordinary talc serves some of the purposes to which the massive variety called POTSTONE (Steatite or Soapstone) is applied. The name is also sometimes given to the material of which the shades hung above gas-lights to prevent blacking of the ceiling are made; but this is a very different mineral, mica.

TALEGAL'LA. See BRUSH-TURKEY.

TAL'ENT (Gr. *talanton*, a balance, hence anything weighed in the balance) was the highest denomination of Greek and Hebrew weights and money, and was also commonly used by Greek writers as the translation of words signifying a certain weight in other languages. It is necessary to observe that the talent is properly only a denomination of weight. There was no coin of that name, though ingots of a talent were used as money. Coined money only began among the Jews in 530 B.C. after the return from Babylon, but among the Greeks it began about 700 B.C.

The Hebrew talent, or kikkar, contained 3000 shekels; its weight was 93 lbs. 12 oz. avoirdupois, and its value as silver money £396 5*s* 10*d*.

The following were the principal denominations of weight and money among the Greeks:—*obolos*, *drachmê*, *mna*, *talanton*, of which the *obolos* was the smallest. Their relative proportions are shown in the annexed table:—

Obol			
6	Drachma		
600	100	Mina	
36,000	6000	60	Talent.

This system prevailed throughout Greece, but the actual values of the talent varied in different states. Most of these variations may be included under two chief standards, namely, the Attic and the Æginetan.

The value of the Attic talent before the time of Solon

is a matter on which we possess hardly any historical information, though we may perhaps arrive at a very probable result. Looking then at the system after Solon had remodelled the coinage, we find that the Attic silver money was celebrated for its purity; and therefore from the coins of that period which still exist, we may determine the value of the standard with tolerable certainty. Now the chief coin was the drachma of silver, the average weight of which varied little from the time of Solon to that of Alexander the Great. From this we get the following values in avoirdupois weight:—

	lbs.	oz.	cwts.
Obol,	...	..	7·81
Drachma,	...	...	46·86
Mina,	1	2	1·25
Talent,	70	3	15

This was the standard always used for silver money, and was therefore called the "silver standard." Remembering that a pound of silver makes sixty-six shillings, the value of these talents can easily be reckoned.

Besides this there was another standard, the chief weight of which was called *the commercial mina*, and contained 138 drachmæ; that is, not that a commercial mina contained 138 *commercial* drachmæ, but that this was quite a different standard from that used for silver money, its unit being to that of the latter in the ratio of 138 : 100; while the *relative* proportions of the weights were the same in both systems.

The commercial mina was used for all commodities except such as were expressly required by law to be sold by the silver standard; and the former is most probably the real ancient Attic standard as it existed before the time of Solon. The purpose of Solon's change was to lower the value of money in order to relieve debtors. The Euboïc talent was often reckoned as equal to the Attic; but it really had 67 lbs. 8 oz. 10 dwts.

It is a disputed question what was the ratio of the Æginetan to the Attic talent. Pollux says that the Æginetan talent contained 10,000 Attic drachmæ, and the Æginetan drachma 10 Attic obols, which would give the ratio of 5 : 3 for that of the Æginetan to the Attic talent. The authorities of the British Museum, however, regard it now as determined that the weight of the Æginetan talent was 101 lbs. 0 oz. 10 dwts. Another famous talent was the heavy Asiatic weight of Crœsus and the Greek cities of Asia Minor, value 119 lbs. 9 oz. 10 dwts. There were other talents used by the Greeks and Romans. The most important variations of the Æginetan standard were those used in Macedonia, Corinth, and Sicily.

The above were all reckoned in silver money, but there was also a talent of gold, which was much smaller. It was used chiefly by the Greeks of Italy and Sicily, whence it was called the Sicilian talent. It was equal to six Attic drachmæ. When Homer uses the word we must always understand by it this small one of gold. In other classical writers it generally means the Attic talent.

The following are the values of the three principal Greek silver talents in English money:—

		£	s.
Æginetan talent,		£333	6
Attic	Commercial,	320	3
	Solonian,	232	0
Euboïc,		223	11

TAL'FOURD, SIR THOMAS NOON, D.C.L., one of the judges of the Court of Common Pleas, and author of the tragedy of "Ion," was born at Reading in 1795. He was educated at the grammar-school there, under Dr. Valpy; and in 1818 was placed under the celebrated special pleader, Mr. Chitty, in whose office he remained for four years. In 1817 he commenced practice as a special pleader; but during the early period of his career he chiefly depended for support upon his literary exertions, especially as law reporter to the *Times* newspaper and contributor to different periodicals. In 1848 he was knighted and made a judge of the Common Pleas. But his claims to be remembered by posterity are chiefly owing to his dramatic productions, of which his tragedy of "Ion" stands preeminent. It is full of exquisite poetry, and manifests throughout a very high order of imagination, although as an acting play it has not continued to maintain its position. Like Dr. Johnson's "Irene," it is perhaps better adapted for the closet than the stage. The same remarks may be applied to his "Athenian Captive," his "Glencoe," and "The Castilian," the last of which never appeared on the stage. Besides these, he was the author of "Vacation Rambles" and the "Life of Charles Lamb." His death took place suddenly, while addressing the grand jury at Stafford, on the 13th of March 1854. See "Memoir of Sir Thomas Noon Talfourd," by a member of the Oxford Circuit (1854).

TALIACO'TIUS, GASPAR (in Italian *Taliacozio*), was professor of anatomy and surgery at Bologna, where he died in 1553, at the age of sixty-four years. His name is *now known chiefly through his reputation for restoring lost noses; but during his life he was equally celebrated for his* knowledge of anatomy and his excellence as a lecturer.

The work in which he describes his method was first published forty-four years after his death, with the title "De Curtorum Chirurgia per Insitionem, libri duo" (Venetiis, 1597, folio). It is divided into two parts, of which the first is chiefly devoted to a disquisition upon the nose, lips, and ears, and the theory of the operation, which he considers to be exactly analogous to that of grafting upon trees. In the second book he describes the operation itself, which was a very elaborate process, occupying several weeks. His method of forming the nose was by engrafting a portion of the skin of the patient's arm, which was held close to the face by a very ingenious contrivance, until the junction was complete. The operation of forming a nose has been performed in recent times by various surgeons, in a simpler and more perfect manner, by gradually drawing down the skin of the forehead upon a mould made of wax or of similar material.

TALIO'NIS, LEX, is the primitive law of compensation; in Mosaic phrase it is "an eye for an eye, and a tooth for a tooth." *Talio* is the noun made from *talis*, like; and *lex talionis* may be translated the law of like for like. The word forms the basis of our word retaliation. The lex talionis was not, as might appear from its name, a law among the classical nations, but stands as part of the stern Mosaic code—"If any mischief follow, then thou shalt give life for life, eye for eye, tooth for tooth, hand for hand, foot for foot, burning for burning, wound for wound, stripe for stripe" (Ex. xxi. 23), and so again in Leviticus (xxiv. 17)—"And he that smiteth any man mortally shall surely be put to death; and he that smiteth a beast mortally shall make it good; life for life. And if a man cause a blemish in his neighbour, as he hath done so shall it be done to him; breach for breach, eye for eye, tooth for tooth; as he hath caused a blemish in a man so shall it be rendered unto him." See also Deuteronomy xix. 21.

But our Lord, in one of the noblest of his injunctions, if the most impossible of actual fulfilment, set this vindictive law of retaliation aside, substituting for it the Christian virtue of forgiveness (Matt. v. 38; Luke vi. 29).

In early stages of society such a principle of retaliation is of great service. It is the converse of the golden rule, and is as easily intelligible. "Do as you would be done by" and "You shall be done by as you do" are obviously equally fair principles, widely as they differ in nobility of sentiment. Consequently the lex talionis in some form or other is held by most primitive people. In a recent

volume of travels among the Indians of Guiana, South America, Everard Im Thurn relates that a Macusi boy who knew English overheard him apologise to a friend for stumbling against him—"I beg your pardon"—and asked for the meaning of the phrase. This he retailed to his comrades, but the version bore the sense of "me hit you again." A nobler retaliation than one in kind was not thinkable by them.

A mode of evading the rigidity of the law whilst preserving its spirit was current among our own forefathers which is not devoid of ingenuity. Each limb or feature had its price, so much for a tooth, so much for an arm, and even so much for a life, and the scale was higher for a franklin than a churl, and higher for a noble than a franklin, &c. See the articles FINES and WERGILD.

TAL'IPOT or **TAL'IPAT** is the Indian name for some species of palms, distinguished by their immense leaves, and belonging to the genus CORYPHA.

TAL'ISMAN, a term generally supposed to be derived from the Greek *telesman*, consecrated, but according to some authorities of Arabic origin, applied to certain portable objects inscribed with magic formulæ, which were supposed to preserve the wearers from sorcery and other dangers. They were prepared with many superstitious ceremonies at times selected for their astrological importance, a circumstance which distinguishes the talisman from the AMULET. The talisman was probably used originally to avert disease, for we find it mentioned in the history of medicine among all ancient nations. The Egyptians made use of figures of sacred animals, such as the ibis and the scarabæus, which they generally wore suspended from their necks. The Arabs and Turks did the same when they were idolators, but after their conversion to Islam they used instead sentences from the Koran, taken chiefly from the Surah, entitled "The Incantation." These were inscribed on strips of vellum or paper, which were rolled up and inclosed in silver boxes, the latter being worn suspended from the neck. They were also engraved upon signet rings, upon the hilt or the blade of swords, upon helmets or shields, or woven into garments. Among Christians relics of saints, consecrated candles, rods, rosaries, &c., were supposed to possess similar powers, during the mediæval period, and this belief still prevails in many of the Roman Catholic countries of the world.

TAL'LAGE or **TALLIAGE** is derived from the low Latin word *tallagium*, which, as Coke says, "cometh from the French word *tailer*, to share or cut a part, and metaphorically is taken when the king or any other hath a share or part of the value of a man's goods or chattels, or a share or part of the annual revenue of his lands, or puts any charge or burthen upon another; so as *tallagium* is a general word, and doth include all subsidies, taxes, tenths, fifteenths, or other burthens or charge put or set upon any man." It was generally, however, confined in its sense to taxes received by the king from the towns and the royal demesnes. It nearly always took the form of a poll tax, or tax of so much a head (or poll). The most important statute on the subject is entitled "De Tallagio non concedendo," which was passed in 1297 (as an abstract of the *Confirmatio cartarum*). In 1312 Edward I. was again foiled in an attempt at a tallage. In 1332 Edward III. caused such opposition by a similar attempt that he had to re-enact the "De Tallagio," to quiet the discontent which had arisen among the Commons in consequence of the king having taxed by tallage all cities, boroughs, and towns without the assent of Parliament. He was embroiled also with the nobles and landowners, from having attempted, unsuccessfully however, to compel all freeholders of land above the value of £20, to contribute either men or money towards his wars in Flanders. The right to tallage was expressly annulled by the statute of 1340, confirmed in 1348, 1352, and 1377—and the famous "De Tallagio" was formally recognized as a statute in the Petition of Right, 1628.

TALLAHAS'SEE, a city, and the capital of Florida, United States, on the Jacksonville, Pensacola, and Mobile Railway, 155 miles west of Jacksonville, and 21 miles north of the Gulf of Mexico. It is beautifully situated on high ground, and is regularly laid out in a plot a mile square, with broad streets and several public squares, shaded with evergreens and oaks. The abundance and variety of flowers and shrubs give it the appearance of a garden. The business portion is of brick. The public buildings are the capitol, a large three-storey brick edifice, with pillared entrances opening east and west; the court-house, a substantial two-storey brick structure; and the West Florida Seminary, a large two-storey brick building, on a hill commanding a view of the entire city. In the vicinity are beautiful springs, the most celebrated of which is Wakulla, an immense limestone basin, 16 miles distant. The surrounding country is fertile. The city contains the car and machine shops of the railway company and a cotton factory. There are several free public schools, two weekly newspapers, and Baptist, Episcopal, Methodist, Presbyterian, and Roman Catholic churches. The site of Tallahassee was selected as the seat of the territorial government in 1822; it was laid out in 1824, and incorporated as a city in 1827. In 1843 the entire business portion, then of wood, was destroyed by fire. The population in 1880 was 2494.

TALLEYRAND-PÉRIGORD, CHARLES MAURICE, Prince de Benevento, a celebrated French statesman, was born in Paris, 13th February, 1754. He came of an ancient and distinguished family, being the eldest son of the Count de Talleyrand-Périgord, but having been lamed by accident when about a year old, and thus unfitted for the family profession of arms, he was disinherited in favour of a younger brother and trained for the church. He was sent first to the College d'Harcourt, and thence successively to the seminary of St. Sulpice, and to the Sorbonne. He graduated with much distinction at the latter in 1774, and though he had been principally noted during his student years for his gross licentiousness, he duly entered the church, and was presented at court at the coronation of Louis XVI. under the title of the Abbé de Périgord. Soon afterwards he was ordained priest, and obtained the rich abbacy of St. Denis in the diocese of Rheims in 1775. In 1778 he was one of the first to welcome Voltaire on his famous visit to Paris, and in 1780, while yet only in his twenty-sixth year, he was appointed agent-general of the clergy of France. He discharged the functions of this important and lucrative office for eight years, displaying uncommon business tact, and maintaining throughout his reputation for intrigue and gallantry. Brought by his position into contact with Mirabeau, Calonne, and Necker, he obtained a thorough knowledge of finance, and became noted for his prudence and skill as a speculator. In 1788 the king unwillingly appointed him Bishop of Autun, and when the States-general were summoned in 1789 he was elected to represent the clergy of his diocese. A haughty aristocrat at heart, he had yet sufficient shrewdness to see which power was in the ascendant, and he at once identified himself with the popular party. He insisted that his colleagues should join at once the representatives of the Third Estate who had assumed the name of National Assembly, figured conspicuously among the friends of Mirabeau, and gave his support to every liberal measure. It was he who moved the celebration of the celebrated Feast of Federation, held on 14th July, 1790, and in his capacity of bishop he attended at the head of 200 priests, and officiated at the great altar erected in the midst of the Champ de Mars. In the Assembly he reported a plan for the reorganization of public instruction, and advocated the abolition of ecclesiastical tithes, the

assumption by the government of the lands belonging to the clergy as national property, and the assumption of a civil constitution for that order. He was one of the first to swear fealty to the new constitution adopted in 1790, and about this time he resigned his bishopric, but the following year he consecrated the first two of the new constitutional bishops, conduct which brought upon him the denunciation of the Pope as a heretic and schismatic. After the dissolution of the Assembly in 1791, Talleyrand was selected for the mission to England, and in February, 1792, he went to London, nominally in the train of the ambassador, M. de Chauvelin, but he was in reality the ruling spirit of the embassy. He was unsuccessful in his negotiations with the English government, and while in London a letter found in the famous Iron Chest led to his being placed upon the list of *émigrés*, thus terminating his connection with the revolutionary government. He remained in England until after the passing of the Alien Bill, when he received peremptory notice to quit the country, and in January, 1794, he sailed for America. Towards the close of 1795 he returned to France, where he attached himself to the circle gathered round Madame de Staël.

In 1797 he was named minister of foreign affairs, and observing the growing power of Bonaparte, he at once attached himself to his party. When Bonaparte returned from Egypt, Talleyrand procured an interview between him and Sieyès, and prevailed upon Barras to resign, thus greatly contributing to the success of the *coup d'état* of the 18th Brumaire. He was rewarded by his reappointment in November, 1799, as minister of foreign affairs, which office he held till August, 1807, aiding in this capacity in the re-establishment of the peace in Europe, and taking part in the successful conclusion of the treaties of Luneville, 1801, and of Amiens, 1802. On 29th June, 1802, Pius VII. at Bonaparte's request, released Talleyrand from excommunication, and yielding to Bonaparte's injunction he married Madame Grant, with whom he had previously lived for several years. The Pope, however, refused to allow this lady to be presented to him, and Talleyrand is said in his resentment to have counselled the partition of the papal states. It was he also who proposed the seizure of the Duc d'Enghien, and he hastened the arrangements for the execution of this nobleman in spite of the vehement opposition of Josephine. His unscrupulous and able services were liberally rewarded by Napoleon, and after the establishment of the empire he received the office of grand-chamberlain, and in 1806 the principality of Benevento in Italy. Soon afterwards he fell into disfavour and resigned his portfolio, 9th August, 1807, his fall being softened by his appointment to the office of vice-grand-elector, to which a large salary was attached. Thenceforward he was only occasionally consulted by his sovereign, but he gave very free expression to his views on great political questions, and was in consequence deprived of his office of chamberlain in 1809. In 1813 overtures were made to him with a view to his resuming the portfolio of foreign affairs, but he had by this time foreseen the coming downfall of the empire, and he declined to be involved in its ruin. After the defeat of the emperor he secretly sent word to the allied sovereigns to hasten towards Paris, and when the city surrendered, 30th March, the Emperor Alexander took up his residence in his house. His management secured the appointment by the senate on 1st April of a provisional government, and its formal declaration on the day following of Napoleon's dethronement. On the arrival of Louis XVIII. he was appointed minister of foreign affairs, and was made a peer of France. He negotiated the first treaty of Paris, 30th May, 1814; and he was sent as minister plenipotentiary to the Congress of Vienna, in the September of that year. He was surprised there by the sudden return of Napoleon from Elba, and went to Ghent, where he joined the exiled king, Louis XVIII., whom he accompanied to France after the battle of Waterloo. He resumed 8th July, 1815, his office of minister of foreign affairs, but was forced to resign his portfolio on the 28th September of the same year. During the next fifteen years he remained politically under a cloud, though he managed to retain a high position in society, his *salon* being the gathering place of politicians of every shade of opinion. After the Revolution of July, 1830, he was appointed ambassador to England with a princely salary, and held the appointment till 7th January, 1835, after which he retired from public life. He died at Paris, 17th May, 1838. That of the Convention excepted, he had served every government in France from the Revolution of 1789 to his death, but though ever attentive to his own interests, and quite unhampered by conscience, he had his merits even as a politician, and he was certainly a diplomatist of extraordinary genius. He left personal memoirs which, according to his will, were not to be published till thirty years after his death. In 1868 Napoleon III. obtained from the heirs a further postponement of twenty-two years, and in 1872, when an announcement was made that the memoirs were about to be published, the Duc de Montmorency, custodian of the manuscript, refused to violate the pledge given. Notices of the life and character of Talleyrand will be found in all the histories of the Revolution, and several biographies have been published, of which the more important are Salle's "Vie Politique du Prince C. M. de Talleyrand" (Berlin, 1838); Bastide's "Vie Religieuse et Politique de Talleyrand" (Paris, 1838); Sainte Beuve's "Monsieur de Talleyrand" (Paris, 1870); and Pichol's "Souvenirs Intimes sur M. de Talleyrand" (Paris, 1878).

TALLIEN, JEAN LAMBERT, a noted French revolutionist, was born at Paris in 1769. His father was house-steward to the Marquis de Bercy, who became interested in the boy, and undertook the charge of his education. Young Tallien was for some time in a lawyer's office, and for a brief period also was connected with the *Moniteur*. When the Revolution broke out, it was not long until he attracted great attention as a leading patriot. This eminence he owed to his fluency of speech and the zeal with which he propagated extreme ideas. In 1792 he became editor of the Jacobin organ *L'ami des Citoyens*, started to take the wind out of the sails of Marat's violent and hateful *L'ami du Peuple*. He was on terms of the closest intimacy with Marat, Danton, and the rest, and had his full part in the atrocious September massacres, the execution of the king, and the other incidents of that fearful time. Being sent in 1793 as commissioner to Bordeaux, with the function of destroying the last remnants of the crushed Girondins, he and his colleague Isambeau literally revelled in bloodshed. Returning to Paris in 1794 he found his party prostrated. Robespierre's star was now in the ascendant; and Tallien made it convenient to bow before the new influence. He thus managed to be appointed president of the Convention; yet Robespierre always suspected him, and a struggle between the two ensued, which was only ended on the memorable 9th Thermidor (27th July, 1794), when Tallien denounced the dictator, and that denunciation had a triumphant issue. Robespierre had discovered the worthlessness of the man, who was a most disgusting libertine as well as a traitor in grain. It was only a moment of hesitation on the dictator's part which gave Tallien his chance. But the people at large saw in him their deliverer, and for a short time Tallien was all powerful. He suppressed the Revolutionary Tribunal and the Jacobins Club, and himself drew up the acts of accusation against his former colleagues in blood, Carrier, Le Bon, &c., hoping by his exaggerated virtue to wipe out his past sins. With his mistress, the fair Cabarus (Madame de Fontenoy), he gave the gayest balls, introducing the Greek dress of the ancients and other

reactionary vagaries. But the constant exposures of his vileness were at last too powerful, and he was driven from the Council of Five Hundred in 1798. Tallien now lost his importance, and his subsequent career presents little that is worthy of notice. He was employed by Bonaparte in the expedition to Egypt, but was dismissed and sent back to France in 1801. He was captured by an English cruiser *en route*, and brought as a prisoner to England. He survived the Restoration, and died at Paris in great poverty on the 16th November, 1820.

TAL'LIS or **TALLYS, THOMAS,** our earliest writer of church music, was born early in the year 1529. Very little is known of his personal history. He was probably a chorister at one of the two Chapels Royal, and eventually became organist of Waltham Abbey. In 1540 the monastery was dissolved and Tallis was discharged with the rest. He is said to have been organist of the Royal Chapel during the latter part of the reign of Henry and of his immediate successors; but the inscription on his gravestone warrants no such assertion. He was simply a gentleman of the chapel, and served for $7\frac{1}{2}d.$ per day. It appears from the title of the noble collection of sacred music, the "Cantiones Sacræ," published jointly by him and Byrd in 1575, that they were at that time gentlemen of Queen Elizabeth's chapel, and also organists. They call themselves "serenissimæ reginæ majestati à privato sacello generosi et organisti." The "Cantiones Sacræ" were the first fruits of one of those monopolies with which the great queen did at once so much good and so much harm. Tallis and Byrd had just previously obtained letters patent conferring on them the exclusive right of printing music and ruling music paper for twenty-one years, which to our eyes appears a monstrous and unwarrantable interference with the liberty of the subject. This work was published at a time when the performance of the church service in Latin was no longer permitted; and it has been, therefore, supposed that the anthems and hymns which it contains, and which are in that language, were composed by Tallis and Byrd for the use of Queen Mary's chapel, and at a time when they were of the Romish persuasion. Tallis's conscience was flexible, and he retained his post from Henry VIII. to Elizabeth, through all the various changes. After the accession of Elizabeth, Tallis appears to have finally embraced the reformed faith, for he set to music the parts of the English liturgy usually sung. He composed the morning, evening, and communion service, including the litany and responses, to this day in continual use, besides a great number of English anthems. These compositions in their style have never yet been surpassed in learning, gravity, and pure devotional expression; and they are still made use of in our cathedrals on the greatest and most solemn occasions. But the most remarkable piece of music due to Tallis is his celebrated song of forty real parts for eight choirs of five parts each. Perhaps this is the triumph of the old formal counterpoint. It is of course rarely performed. Mr. Henry Leslie's Choir gave some performances of it with three voices to a part (120 voices in all) in 1878-79. Tallis died on the 23rd November, 1585, and was buried in the parish church of Greenwich, Kent. He appears to have been of a serious and devout character, and his talents were wholly devoted to the service of the church.

TAL'LOW is animal fat melted and separated from the membranous matter which is naturally mixed with it. When pure, it is white, and nearly tasteless; but the tallow of commerce usually has a yellow tinge. A very large proportion of that used in this country is of home production, and is fitted for use by the *renderer*, who chops into pieces the fat and suet received from the butchers, and boils it in water, by which operation the greater part of the fat is melted out from the membranes, and floats to the top, whence it is removed by skimming. The remaining fat is subsequently squeezed from the membranes by a powerful press, leaving the membranous matter in the form of a cake or block, of a dark colour, which is called *graves*, and which, when macerated in warm water, softens and swells, and becomes a wholesome and palatable article of food for poultry, dogs, and other domestic animals.

Tallow is still produced in large quantities in Russia, but not to such a great extent as formerly. It is mostly furnished from the steppes of Southern Russia. The cattle are bought by thousands, driven to the *salgans* or tallow factories, and there fattened and slaughtered. After the animals are slaughtered and skinned, a little of the flesh and the intestines are removed, and the rest of the carcase, cut into pieces, is thrown into the boilers, of which there are from four to six in every salgan, each large enough to contain the flesh of ten or fifteen oxen. During the boiling, the fat as it collects at the top is skimmed off with large ladles; and before it is quite cold it is poured into the casks in which it is afterwards shipped. The first fat which comes off is the best, and is quite white, while that which follows has a yellowish tinge; and a still coarser tallow is obtained by squeezing the bones and flesh in presses.

Different kinds of tallow melt and retain their fluidity at very different degrees of temperature; the fat which is deposited about the kidneys being, in all animals, harder than that found in the cells of the bones, and especially than the half-oily fat found in the muscles and other soft parts; while the fat of some animals is harder than that of others—that of the sheep and deer, for example, congealing much sooner than that of the ox or horse. The chief uses of tallow are noticed under SOAP. The trade in it is declining, owing of course to the increasing use of the paraffin and petroleum oils and other light-giving materials. The imports into the United Kingdom in 1886 amounted to 1,010,396 cwts., value £1,296,552. The largest supplies were received from the United States and Australia, to which countries the trade has of late years shifted.

TALLOW-TREE (*Stillingia sebifera*) is a tree belonging to the order EUPHORBIACEÆ. This tree is a native of China and the Eastern Islands, but has been successfully naturalized in India and the warmer parts of America. Its capsules contain three seeds, thickly coated with a white fatty substance, which is manufactured by the Chinese into candles. The seeds and capsules are boiled and bruised, and the fat is made into flat round cakes, and subjected to a heavy pressure. The pure tallow thus obtained soon hardens into a white brittle mass, which, to prevent its melting in hot weather, is coated with insect-wax. A black dye is procured from its leaves; the wood is used for printing-blocks.

TAL'LY does not come from *talis* or *talio* ("like for like"), as might be surmised, but from the Norman French *tailler*, to cut. The original tally was half a stick which had been notched across; the debtor and creditor each keeping a half when the tally was split down lengthwise, and so preserving exact duplicates of the record of the transaction. The other half of the original stick was called the *stock*. Hence the name "Stocks" for government securities, since the stocks recording the debits of the government were kept in the Tally Office in the Exchequer. Tallies were not disused as records of payment to or from government till 1826; and such an enormous quantity of them had accumulated that they were long used as firewood. It was through this practice that the Houses of Parliament were burned down, together with St. Stephen's Chapel and many interesting relics, in 1832.

The use of tallies in Stock Exchange transactions was very great, and finally proved so cumbrous that an Act was passed in 1783 enabling paper or parchment certificates to be used in the place of these bundles like faggots, which used to be passed from hand to hand.

TALMA, FRANÇOIS JOSEPH, a celebrated French tragic actor, was born at Paris on the 15th of January,

1763. His father, who was a dentist, trained him for the same profession, but the boy gave early indications of histrionic talent. Part of his early life was spent in England, and Lord Harcourt was among the first to encourage him to go upon the stage. He returned to Paris, made the acquaintance of some of the popular actors, and studied declamation under Molé and Dugazon. Nevertheless he still practised dentistry, to which profession an unfavourable verdict of some friends on his first trial as an actor had well-nigh doomed him for life, when an actress named Samval encouraged him to make a *début* at the Théâtre Français. On the 21st November, 1787, he appeared in the character of *Seïde*, and was completely successful. In less than two years he stood in the first rank of the actors of the day. In 1789 he achieved a great triumph in the performance of the leading character in Chenier's play of "Charles IX.," a piece deemed by the government of the day too exciting to be long kept on the stage. The political animosities which it aroused led to a duel between Talma and a fellow actor, Naudet. Among the great tragedian's intimate friends was General Bonaparte, who on ascending the throne of France continued his regard for the actor. He even took lessons from Talma in preparing for his coronation as emperor. During the Reign of Terror Talma's life had been spared mainly on account of his popularity with the playgoers, yet after the fall of Robespierre he was accused of being a Terrorist. He wrote a letter of adieu to Napoleon on his abdication, which touched the conqueror all the more by contrast with the desertion of more powerful friends. Louis XVIII. befriended the actor no less than the emperor had done; and when Talma died on the 19th October, 1826, the mourning was general and sincere. His eulogy has been written by such distinguished persons as Madame de Staël and Chateaubriand. He published in 1825 "Reflections on Le Kain and the Theatrical Art."

TAL'MUD, a name derived from the Hebrew word *lamad*, to learn, used to designate the whole body of the canonical and civil law of the Jews, and to the compilations in which this is contained. These compilations consist of two parts, the MISHNAH and the Gemara, the former being the text and the latter the commentary and complement. The Pentateuch is in all cases the background and latent source of the Mishnah, for this was always accepted as the immutable, divinely-given constitution, the *written* law; in contradistinction to it the Mishnah together with the Gemara was called the oral or *unwritten* law, and it thus had some points of resemblance with the unwritten Greek *rhetrai*, the Roman "Lex non scripta," and the English Common Law. There are few chapters in the whole history of jurisprudence more obscure than the origin, development, and completion of this "Oral Law." Whatever may have been the date and origin of the Pentateuch, there must have existed almost from its very beginning a number of corollary laws, which explained in detail most of the rules broadly laid down in it, and these in course of time became both numerous and elaborate. About the middle of the first century of the Christian era the oral law, embodying national customs, traditions, and legal precedents was expounded chiefly in the rival schools of Hillel and Schammai, and the teaching of these schools was continued by certain great Rabbins, called by the Jews the Thanaïm, until about the year 230 A.D. when it is believed the redaction of the whole into one complete cod was attempted, and the result committed to writing by Rabbi Jehudah the Holy. This transcription constitutes what has ever since been known as the Mishnah, and this became in its turn what the Scriptures had become before a basis of development and discussion. It became obscured by speculations, and traditions sprang up, new methods o interpretation were invented, casuistry developed, and th Gemara ensued. This Gemara consists of annotations discussions, amplifications, and explanations of the Mishnah and in its turn it is divided into two portions, the HALACAH Hebrew, "rule," "guide"), which consists of purely legal matter, and the HAGGADA, a vast collection of homilies, tales, gnomes, legends, and the like. The Halacah embodies the precedents established by the Rabbins, and their decisions in questions religious, social, and political, and is perhaps chiefly the work of the Thanaïm, while the Haggada is chiefly due to later expositors and teachers of the Babylonian schools known as Amoraïm. There were originally two Gemaras, the Palestinian, redacted at Tiberias, and known as the Jerusalem Talmud, and the Babylonian Talmud, redacted at Sura, in Babylonia, under the editorship of Rabbi Ashe (365–427 A.D.) The final close of his codex, however, the collecting and sifting of which took about sixty years, is due to the Rabbinic school of Saboraim at the end of the fifth century A.D. The Mishnah, which is the same in both Talmuds, is written in the Hebrew dialect used after the exile; the Gemara of the Jerusalem Talmud being written in what may be called the "Eastern Aramaic," the language of the other being that of the Western Aramaic. In both the style is very rough and difficult, but the Babylonian Gemara is purer in grammar and vocabulary than that of Jerusalem. The Babylonian Talmud includes a number of traditions known as Beraitha, which were excluded from the text of the Mishnah, by the schools of Tiberias, and its commentary is much more luminous. Speaking roughly, the Babylonian Talmud is about four times as large as that of Jerusalem, and its thirty six treatises now cover 2947 folio leaves, in twelve folio volumes.

The Talmud, as such, was never formally accepted by the nation, by either general or special council, and indeed the genius of the whole work would render this an impossibility. In the whole structure of the work its argumentative character is implied, and it has been asserted that it would be difficult to find throughout the whole of the Talmud a single subject upon which the doctors, Thanaïm or Amoraïm, are agreed. Freedom of opinion was at all times conceded by the Rabbins, most of whom accepted the maxim that "Every dispute which has for its object the cause of Heaven deserves to be perpetuated," and for the precedents recorded in the Talmud no more is claimed than that they represent the deliberately formed opinions of the best and wisest for the time being. Every question, however, is debated with great vigour and earnestness, the veriest trifles being carefully noted equally with the most important essentials. In all the discussions a very high value is set upon intellect or reason, and one remarkable legend conveys the lesson that not even a miracle should be allowed to convince a man against the decision of his own mind. The general character of the laws of the Mishnah is humane in the extreme, in spite of certain harsh and exceptional enactments issued in times of misery and danger, which for the most part never were and never could be carried into practice. A remarkable feature of the Talmud also is the wonderful tone of liberalism pervading its doctrines. The divine origin of the Mosaic code is indeed assumed, but the Talmud does not hesitate to annul or even abrogate its express ordinances when these are considered burdensome or oppressive, or no longer in consonance with the spirit and requirements of the age. Even the most heterodox opinions of the Rabbins are allowed a place in the Gemara, and it is curious to note that in very many instances these anticipate the arguments advanced by the most recent criticism of the present day. Even the startling opinion of Rabbi Hillel, "that there would be no Messiah," though it goes directly against the most cherished doctrine of Judaism, finds a place in the Talmud, together with the wild imaginations of others concerning the glories of Messiah's kingdom. For Old Testament interpretation, the Talmud is comparatively useless, but the light it affords for the study of the early

history of Christianity is simply invaluable. In all modern works upon the life of Jesus and the foundation of the Christian Church the importance of the Talmud is recognized, and the compilation is undoubtedly the most trustworthy source of information concerning the spiritual condition of the Jews of that period, together with the details of their social life and domestic economy.

After having been universally condemned by Christian doctors, and the MSS. often burnt, the defence of the Talmud was undertaken mainly by the German reformer Reuchlin, in the sixteenth century, and between 1520 and 1523 the Babylonian Talmud, in twelve vols. folio, and the Jerusalem Talmud in one vol. folio, were printed at Venice. The subsequent editions, including the most important commentaries and notes, are very numerous. They are so arranged that the Mishnah and Gemara in square Hebrew characters without vowel points occupy the centre of the page, and the chief commentaries and notes the margins all around, other commentaries being added at the end of each treatise. One of the fullest is the Warsaw edition of the Talmud of Babylon (1857 *et seq.*)

See article "Thalmud" in Herzog's "Real Encyclopädie für Theologie und Kirche;" Emanuel Deutsch, "Literary Remains;" and Rabbinovicz's "Legislation Civile du Talmud" (Paris, 1878). No complete translation of the Gemara has ever been made.

TAL'ON, the claw of a bird of prey (from Latin *talus*, the heel). The word is also used in monetary circles to designate the "heel" or last portion of a bond remaining when all the coupons are torn off; and it usually bears an address when upon presentation of it a new bond will be given in exchange.

TAL'PIDÆ. See MOLE.

TAL'US, a term applied by geologists to the accumulation of unworn fragments at the base of cliffs and precipices, derived from the weathering of the exposed rock.

TAMAN'DUA. See ANT-EATERS.

TA'MAR, a river of England, which flows S.S.E. between the counties of Cornwall and Devon, and, forming an estuary (called Hamoaze), falls into Plymouth Sound; length 60 miles. It is celebrated for its beautiful scenery.

TAM'ARIN. See MARMOSET.

TAM'ARIND (*Tamarindus indica*) is a species of plants of the order LEGUMINOSÆ, sub-order Cæsalpineæ. It is a native of India and the surrounding islands, but has been naturalized in the West Indies, and in Brazil and Mexico. It is a tall handsome tree, with large compound pinnate leaves forming a dense foliage, and racemes of fragrant flowers, which are yellow streaked with red, and have purple filaments and brown anthers. The fruit, the well-known tamarind of commerce, is a long pod, straight or slightly curved, with a hard brittle brown exterior shell. The pods imported from India are from 3 to 6 inches long, and contain from six to twelve seeds; those of the West Indian variety are shorter, and contain from one to four seeds. The seeds are invested by a thin membranous covering, outside which, and between it and the shell, is a firm, juicy, acid, brown pulp, traversed by strong woody fibres. In the East Indies the pulp is dried either in the sun or artificially, with salt added, which latter kind is sent to Europe. The West Indian tamarinds are put into jars with layers of sugar between them, or with boiled syrup poured over them, and are called prepared tamarinds. They have a sharp, penetrating, and agreeable acid taste, softened by a sweetish one. Tamarind pulp, when analyzed, is found to contain citric, malic, and tartaric acids, with sugar, potash, vegetable jelly, &c. The pulp is frequently employed in medicine; it is cooling and gently laxative, and is peculiarly grateful in fevers and inflammatory diseases. In hot countries tamarinds are regarded as of the highest value for the preparation of refreshing beverages. Tamarinds are also used in India as an addition to curries, and in preserving or pickling fish. The seeds are used medicinally in dysentery in some parts of India, and in Ceylon they are used as food in times of scarcity. The flowers, leaves, and a decoction of the bark have also had medicinal virtues ascribed to them. An infusion of the leaves yields a yellow dye. The wood is very firm, hard, and heavy, and useful for building purposes; it also yields a fine charcoal for the manufacture of gunpowder.

The name tamarind is also applied to some similar fruits belonging to the genus Dialium. The Velvet Tamarind (*Dialium guineense*) of Sierra Leone has a pod about the size and shape of a filbert, covered with a black velvet down; the pulp surrounding the seeds has an agreeable acid taste. The pod of the Tamarind Plum (*Dialium indicum*) of India contains a pulp resembling in flavour that of the tamarind, but less acid.

TAMARIS'CINEÆ is a small order of plants belonging to the group Polypetalæ, cohort Caryophyllinæ. The species are found chiefly in the Old World, the greatest number being met with in the basin of the Mediterranean. The plants of this order are innocuous and all more or less astringent; and the ashes of those growing near the sea after burning are remarkable for possessing a large quantity of sulphate of soda. The species are shrubs or undershrubs, rarely trees or hard prostrate herbs, and are found chiefly in sandy districts near the sea, or by mountain torrents, lakes, and rivers. The leaves are usually small, entire, and alternate, often fleshy or scale-like. The flowers are generally in close spikes or racemes, sometimes solitary. The calyx is four or five-parted; the petals are distinct or coherent, equalling the sepals or twice as many, and in one genus (Fouquiera) united into a tubular corolla; the ovary is superior, imperfectly divided into three cells. The capsule is three-valved, one-celled, with numerous hairy or winged seeds.

TAM'ARISK (Tamarix) is the name of a genus of plants, the type of the natural order TAMARISCINEÆ. The species are natives of the warmer parts of Europe, Asia, and Africa. They are shrubs or small trees with rod-like branches, minute scale-like leaves, and small flowers in close spikes. The Common Tamarisk (*Tamarix gallica* or *anglica*) is a native of the countries bordering on the Mediterranean, and has been naturalized in some parts of the south-west coast of England. It has small pink flowers. Its ashes yield a large quantity of sulphate of soda. The bark is slightly bitter and astringent, and has been used in medicine as a tonic. *Tamarix mannifera*, which is probably only a variety of this species, produces in Arabia a substance called by the Arabs *manna*, and relished as a great dainty by them. This substance drops from the tree from punctures made by a gall-fly, and falls on the fallen leaves and twigs on the ground; and is collected, cleansed, and eaten like honey or butter with bread. It is certainly not the manna of Scripture. *Tamarix orientalis* (the Eastern Tamarisk) is one of the largest and most elegant species. One of the finest specimens of this tree existing is at Babylon. Galls are found upon this plant, which in India are used medicinally and for dyeing. Several other species have been described which are probably only varieties of these two species. Nearly all are elegant and delicate shrubs, deserving a prominent position in the shrubbery.

TAMATAVE, the chief seaport on the east coast of Madagascar, is a small town with about 7000 inhabitants, and the chief port of the island. It was occupied by the French in their operations of 1885-86.

TAMBOUR' WORK. A kind of embroidery in which threads of silk, gold, or silver, are worked by needles of a peculiar form into leaves, flowers, &c., upon a stuff of silk, linen, or muslin, stretched over a circular frame like a drum-head (tambour), whence its name.

TAMBOUR'A or **TANBOUR'**, a sort of guitar or rather mandoline, found in Arabia, Persia, and Hindustan, a variety of the Egyptian *nefr* or *nofr*. The neck is long, and the body, of gourd-shape, is beautifully carved or lacquered. The strings are of metal, and are plucked with a plectrum of tortoise shell or vulture's quill, &c. The instrument has, it is almost needless to add, absolutely nothing to do with *tambourine* or *tambour* (French for "drum").

The tamboura, as used by the Arabians and Persians, is found upon the bas-reliefs of ancient Assyria, and in paintings of ancient Egypt certainly as old as B.C. 1500. The *nebel* of the Hebrews, variously translated psaltery, lute, and viol, is really a tamboura in all probability. Ganesan, the elephant-headed god of wisdom among the Hindus, is represented always as holding a tamboura in his hands.

TAM'BOURIN, the national drum of Provence, has no relation to tambourine other than the identity of name. It is strictly a small drum with a very elongated cylinder, carrying two parchment drum-heads, and is beaten with a small drumstick, the other hand of the performer holding it up, and at the same time being occupied with the second national instrument, the *galoubet*, a small pipe with three holes. The effect of the two instruments when played *con amore* at festivals in Provence is as stirring to a Provençal as the sound of the bagpipe to a Highlander, and the famous description of a prize competition in Daudet's novel "Numa Roumestan" is not in the least overcharged. Even to strangers and foreigners the local skill on the tambourin and galoubet is admirable.

TAM'BOURIN is the name of an old Provençal dance taken from the instrument which accompanied it (see previous article) in the same way as our "hornpipe." Later on, the dance was used as a "form" in music, as with so many other dance-rhythms; and in this case the bass was made to consist of repetitions of the tonic and dominant, drum fashion. The best known example is the excellent harpsichord piece by Rameau, perhaps the most familiar of his writings. The tambourin runs in sections of eight bars, repeated, and should be lively and full of little runs and turns, imitative of the well-known methods of pipe-players; for the melody of the dance was originally played upon the three-holed galoubet to the drum-bass of the tambourin, and if the characteristic style is lost the piece loses its peculiar flavour. The usual musical form follows the Minuet and Trio style, the middle part (or Trio) being usually in the minor, and the last part like the first but without repeats.

TAMBOURINE, an ancient musical instrument of percussion of the drum species, consisting of a hoop of about 6 inches deep, covered at one side with parchment, and hung round with little bells or "jingles." It is played by striking it smartly with the hand, fingers, or elbow. Another effect is the "travale" produced by drawing the wetted fingers or the thumb round the edge of the skin, which then emits a muffled sound, very characteristic, mixed up with the sharp tinkle of the "jingles." The "roll" is performed by shaking the instrument so as to move the jingles rapidly. It is the pleasure of expert performers to display their ingenuity in tossing the tambourine without disturbing their playing, in twirling it upon the point of the finger, &c.

Its French name, "tambour de Basque," was given it on account of its Biscayan origin, as it came from Spain to France through Biscay. At the close of last century it was not unusual for high-born French ladies to practise this little instrument, which so easily lends itself to graceful attitudes, while a musician at the harpsichord supplied the musical part of the duet. It is now chiefly in vogue among the peasantry of Italy and Spain, but is occasionally met with in England. We find the tambourine in the Egyptian and Assyrian sculptures of untold antiquity. The Greek *tumpanon* was but a tambourine with both sides covered. The modern Egyptians use a small variety of the instrument which they call *rikk*, and which is covered with fish skin in lieu of parchment; the larger kind is covered with goat's skin. The modern Hindu uses a small stick as well as the hand to his *dayra* or *surya prabai*.

TAMBOV', a town of Russia, the capital of a government of the same name, situated nearly in the centre of the government, on the Tsna, 385 miles south-east from Moscow, and 750 from St. Petersburg. It has about 36,000 inhabitants. The town has been much improved since the beginning of this century, but almost all the houses are of wood. The principal buildings are—the monastery of Our Lady of Casan, several churches, the gymnasium, and the civil and military hospitals. There is a military school, a seminary for priests, a high school for ladies, and a district school. The Bishop of Tambov resides in this city. The inhabitants manufacture shawls, kersey, sailcloth, cordage, and woollen cloth; and there is an imperial alum and vitriol factory. Tambov has an active trade in leather, wool, tallow, and salt beef. The town was founded and strongly fortified in 1636, as a defence against the incursions of the Tartars.

TAM'ERLANE. See TIMUR.

TAM'IL, TAMIR, or **TAMUL**, one of the Dravidian or South Indian family of languages, spoken by about 10,000,000 of people inhabiting the Karnatic plain, from Palicut to Cape Comorin, and from the Ghats to the Bay of Bengal. It is also spoken in the north and north-west of Ceylon, and in the southern part of the Travancore country. Its alphabet consists of twelve vowels and eighteen consonants. The earliest work in this language dates no further back than the eighth century, and the most famous is the "Ku Ral" of Tiru Valluvar Nayannar, a collection of ethical and political aphorisms. This was published in London with both a Latin and an English translation in 1886. [See TIRU VALLUVAR.] As regards the rank of Tamil as a language, competent observers have declared it to be a finer language to think and speak in than any of the European tongues.

TAM'INY, a thin highly glazed stuff made of worsted, which, under the name of *lasting* or *durant*, is much used for ladies boots. It is also employed, undyed, to make a taminy or tami sieve for straining sauces in cooking.

TAM'MUZ, a word which only occurs once in the Bible, in Ezek. viii. 14: "And, behold, there sat women weeping for Tammuz." It is supposed by most critics to be a name of the Phœnician god Adonis, who, according to the legend, was beloved by Aphroditê when a beautiful youth, slain by a wild boar, and raised among the celestial divinities. His worship was introduced into Greece at an early period. The river Adonis (Nahr Ibrahim) was reputed once a year to flow to the Red Sea with his blood: the fact being, that after the storms it carried down some of the red soil of Lebanon. The Syrian women, in their festivals, first mourned the death of Adonis, and then indulged in riotous celebration of his return. In all probability he was a personification of the sun and of its influence upon vegetation. His feasts began with the new moon of July, whence the month in which they fell received the name of Tammuz.

TAM'PAN, a species of TICK (Ixodidæ) closely allied to the poisonous Tick of Persia (*Argas persicus*). This large poisonous mite was met with by Dr. Livingstone at Ambaca, a town not far from St. Paul De Loando, on the west coast of Central Southern Africa, in the month of April, 1854. He afterwards refers to it as occurring at Tete on the east of the same tract, where the Portuguese settlers have named it *Carapatos*, or "the house haunter." Livingstone says, "It chooses by preference the parts between the fingers or toes for inflicting its bite. It is seen

from the size of a pin's head to that of a pea, and is common in all the native huts of this country. It sucks the blood until quite full, and is then of a dark blue colour, and its skin is so tough and yielding that it is impossible to burst it by any amount of squeezing with the fingers. I had felt the effects of its bite in former years, and eschewed all native huts ever after, but as I was here again assailed in a European house (that of the commandant of Ambaca), I shall detail the effects of the bite. These are a tingling sensation of mingled pain and itching, which commences ascending the limb until the poison imbibed reaches the abdomen, where it soon causes violent vomiting and purging." Where these effects do not follow fever sets in, and death sometimes results.

TAMPICO, PUEBLO NUEVO, or **SANTA ANNA DE TAMAULIPAS,** a seaport town of Mexico, 215 miles N.N.W. of Vera Cruz, on the south shore of the Lake of Tampico. Population, 15,000. It is regularly laid out on a slope, and has some good dwellings in the old Spanish style, with military and naval hospitals, several public monuments, and well supplied markets. Large quantities of prawns, caught in the Lake of Tampico, are salted for transmission to the interior. The town is better drained and less unhealthy than formerly. It has an important trade with the United States and Great Britain. The principal exports are specie, hides, tallow, jalap, sarsaparilla, bones, and jerked beef. There is a bar at the entrance to the harbour, so that only vessels of light draught can come up to the port. Larger ones have to discharge in the roads outside.

TAMP'ING, a term used by miners to express the operation of filling up the hole bored in a rock for the purpose of blasting it with gunpowder. The powder being first put into the hole, and a tube for a conductor of the fire, the hole is rammed to fulness with brick dust, sand, or other matter.

TAM'SAY, a river and seaport on the north coast of the island of Formosa. The foreign trade of the island has passed to this port from that of the capital Tai-wan, which was opened in 1858, on account of the insecurity of the latter.

TAM-TAM, or **TOM-TOM,** a kind of native drum used in the East Indies and in Western Africa. Usually it is made of a hollow cylinder formed of fibrous wood, each end covered with skin. Sometimes only one end is so covered. The name tam-tam is given by the French to the gong when used as an orchestral instrument, though the gong has but little affinity to the little Hindu hand-drum whose name in Sanskrit (*tam-tam*) is of unknown antiquity. The modern Egyptian wooden bottle-drum (like a wide-necked open water bottle with a drumhead in place of the bottom) is perhaps classible as a tam-tam. The native name is *darabukkeh*.

TAM'US is a European genus of plants belonging to the order DIOSCOREACEÆ. *Tamus communis* is the well-known black bryony of the English hedges, and has thick fleshy roots, whose annual twining stems grow to a great length and climb over bushes and hedges. It may be distinguished readily from the common BRYONY (*Bryonia dioica*) by its shining, hairless heart-shaped leaves. It has small yellowish, green, bell-shaped, diœcious flowers in axillary racemes. The male flowers have six stamens; the female have the perianth adhering to the ovary and persistent, and very short rudimentary stamens. The fruit is a red roundish three-celled berry. The roots contain a quantity of sour clammy juice, and were formerly used in the preparation of stimulating plaisters, and to remove the discoloration of the skin produced by blows or bruises. The fruits, steeped in gin, form a popular remedy for chilblains. An allied species (*Tamus cretica*) is found in Greece and the islands of the Greek Archipelago, its young suckers being used like asparagus.

TAM'WORTH, a municipal borough of England, in the counties of Stafford and Warwick, in the north or Tamworth parliamentary division of the latter county, 7 miles south-east from Lichfield, and 110 miles north-west from London, by the North-western Railway, situated on the north bank of the rivers Tame and Anker, just at their junction, consists of several streets somewhat irregularly laid out, but well paved. A very ancient, rude, and irregular stone bridge, extremely narrow, inconvenient, and dangerous, crosses the Anker from Tamworth to Bolehall. There is a tolerably handsome bridge over the river Tame just below its confluence with the Anker, over which rises the old castle, with its commanding keep tower. The parish and borough extend into Warwickshire; the parish church, however, a large and handsome semi-Norman building with a fine tower, is in Staffordshire. There are several chapels of ease, a Roman Catholic chapel, and places of worship for Independents, Wesleyans, Baptists, United Methodists, and Unitarians, grammar and other schools, several benevolent institutions, and a town hall, with an old subterranean prison beneath it. The inhabitants are principally employed in brick-making, brewing, dyeing, and the manufacture of paper, tape, and smallwares. The municipal borough, which is governed by a mayor, four aldermen, and twelve councillors, has a population of 4,888. The eminent statesman, Sir Robert Peel, whose seat, Drayton Manor, was about 1½ mile to the south of the town, and to whose memory a bronze statue was erected in the market-place in 1852, represented this borough in Parliament for many years. Tamworth was a capital of the Mercian kings in the Saxon times. It was incorporated in the third year of Elizabeth, and sent two members to Parliament from a very early period till 1885, when its representation was merged in that of the county.

TAM'WORTH, a town of New South Wales (251 miles north of Sydney, and 163 miles from Maitland), is situated on the Peel and Cockburn rivers and Goonoo-Goonoo creek. The Peel River divides it in the centre, and is spanned by a handsome iron bridge. The town is situated on low ground, surrounded by a range of undulating mountains, in the midst of a fine pastoral, agricultural, and mining district, and is gradually growing into importance as these interests become developed. The town of Tamworth was incorporated in 1876; it has 32 miles of streets (most of which are planted with ornamental and foliage trees, while the reserves and other public grounds are being greatly improved) and public buildings. The population in 1881 was 3620.

TAN'AGER (Tanagridæ) is a family of passerine birds nearly allied to the Finches (Fringillidæ). The tanagers are confined to America, the great majority of the species, of which over 300 have been described, being found within the tropical parts of that continent. They are distinguished by the presence of a notch on each side of the upper mandible near the tip. They are mostly small birds of very brilliant plumage, living in flocks amid the trees of the forests, and feeding on soft fruits and insects.

The Scarlet Tanager (*Pyranga rubra*) is one of the few species that visit the United States during the summer, arriving in May, and going as far north inland as Lake Huron; it also breeds in New Brunswick and Nova Scotia. The male in the breeding season is of the most brilliant scarlet colour, with the wings and tail velvety black; at other seasons his plumage is scarcely distinguishable from that of the female and young, which is dull yellowish-green. The total length is about 7¼ inches. This bird is very shy and unsociable, dwelling in the recesses of the forests, and rarely approaching human habitations. Its food consists of beetles, wasps, bees, and other insects, and their larvæ, and also to some extent of berries and fruits. Its nest is a slight structure, composed of dry grass and flax

stems, and is placed usually upon the horizontal branch of a tree; the eggs are three to five in number, dull greenish-blue, speckled with brown and purple. The ordinary note of the male is a mere monotonous chirp, but occasionally, especially in the breeding season, he utters a more varied and musical chant. The Mississippi Tanager or Summer Red Bird (*Pyranga æstiva*), another visitor to the United States, is of a light red colour, dusky on the back, with the tips of the wings brown; the female and young male are olive brown above and reddish-yellow beneath. It is about the same size as the preceding species, which it resembles generally in its habits, but does not range so far north.

The Organist Tanager (*Euphonia musica*), a native of the West Indies, is remarkable for the sweetness and compass of its voice. It is about 4 inches long, with the upper surface brilliant violet black, the top of the head and nape of the neck blue, and the cheeks blue-black; the forehead and lower surface are orange. The female is olive above and greenish-yellow below. Of the genus Calliste about sixty species are known, inhabiting the dense forests of South America, most of them birds of very brilliant plumage. One of the best known, the Lesser Rufous-headed Tanager (*Calliste cayana*), is very common in British and French Guiana, where it is said to do much damage to the rice-fields. The species of the typical genus Tanagra are also numerous, inhabiting the forests of South America; and there are several other genera containing a large number of species.

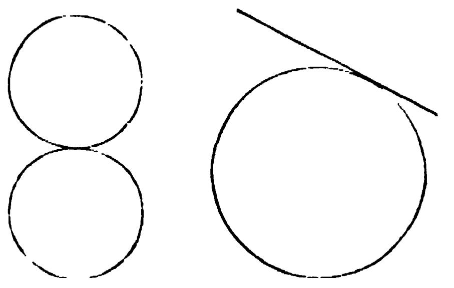
TANANARI'VO, or **ANTANARIVO,** the capital of the kingdom of the Hovas, near the centre of the island of Madagascar, with a temple and fortifications after the European manner. It stands on a hill, the highest part of which is occupied by the royal palace, with steep roof and double verandahs. Beneath lie the houses of the members of the royal family. The town itself consists of wooden houses, with high, narrow roofs, standing on artificial terraces. Altitude, 4790 feet. The population is estimated at 80,000.

TANBOUR'. See TAMBOURA.

TAN'CRED, one of the most illustrious leaders of the First Crusade, is said to have been the son of a Norman baron, Count Eudes, and of Emma, daughter of Tancred of Hauteville, and sister of the great Norman chief, Roger Guiscard, and to have been born about 1078 A.D. Some chroniclers profess to give numerous details of his early life, describing him as a youth of great prowess and wonderful wisdom; but the first authentic information we possess is that on the proclamation of the First Crusade by Urban II., Tancred assumed the cross, and accompanied his cousin Bohemund, son of Robert Guiscard, to the East. He crossed the Bosphorus in the disguise of a common soldier, so that he might escape from swearing allegiance to the Byzantine emperor Alexis, but was in the end compelled reluctantly to make the required submission. By his courage at Dorylaion, 4th July, 1097, he saved the camp of the priests and women from destruction, and in the siege of Antioch the chroniclers assert he slew 700 of the Saracens. He transmitted seventy of the heads of the latter to the Pope, who sent a present of seventy silver marks in return. With Robert of Normandy he first set foot in the Holy City, 15th July, 1099, and he was one of the claimants of the throne of Jerusalem, though his claims were set aside in favour of Godfrey de Bouillon. The latter appointed him to the principality of Galilee, which he governed in conjunction with that of Antioch for his cousin Bohemund until 1122, when he died at Antioch from a wound received in battle. His character and career have been delineated with all sorts of fictitious embellishments by Tasso in the "Gerusalemme." The chroniclers of the period speak of Tancred in terms of the most extravagant laudation, and Gibbon in his history asserts that "in the accomplished character of Tancred we discover all the virtues of a perfect knight, the true spirit of chivalry which inspired the generous sentiments and social offices of man, far better than the base philosophy or the baser religion of the times." (See also G. W. Cox "The Crusades," London, 1874.)

TANGANYIK'A, a lake in the east part of Central Africa, about 400 miles W.S.W. of the Victoria Nyanza. It was discovered by Captains Speke and Burton in 1858. Its length is about 290 miles; average breadth, 23 miles; and area, 5800 miles. The basin in which it lies is inclosed on all sides by a mountain curtain, rising from 2000 to 3000 feet. The lake is of great depth and abounds in fish of various kinds. It was carefully surveyed in 1874 by Lieutenant Cameron, who discovered what he considered an outlet on the western side towards the north. The outflow, however, seemed so trifling that some uncertainty remained. Mr. Stanley visited the lake in 1877, and he admitted Cameron's Lukuga Creek to be an outlet, though almost imperceptibly so. Some agents of the London Missionary Society, who were at Tanganyika in 1879 during the rainy season, set the question at rest, for at that time of the year the waters of the lake poured out by the Lukuga in a perfect torrent, and went to swell the upper course of the Congo.

TAN'GENT. When a circle touches another circle without cutting it, or when a line touches a circle without cutting it, the circle or the line is said to be a *tangent* to the circle touched. Tangents have many properties. For instance, the touch is made at only one point, in the mathematical sense of the point; a tangent line is at right angles



Tangent Circles. Tangent Line.

to a radius of the touched circle drawn from the centre of the circle to the point of contact; the line joining the centres of two tangent circles passes through the point of contact, &c.

The tangent is also one of the principal trigonometrical ratios, being the ratio of the perpendicular to the base in a right-angled triangle; and the cotangent is its converse, the ratio, namely, of the base to the perpendicular.

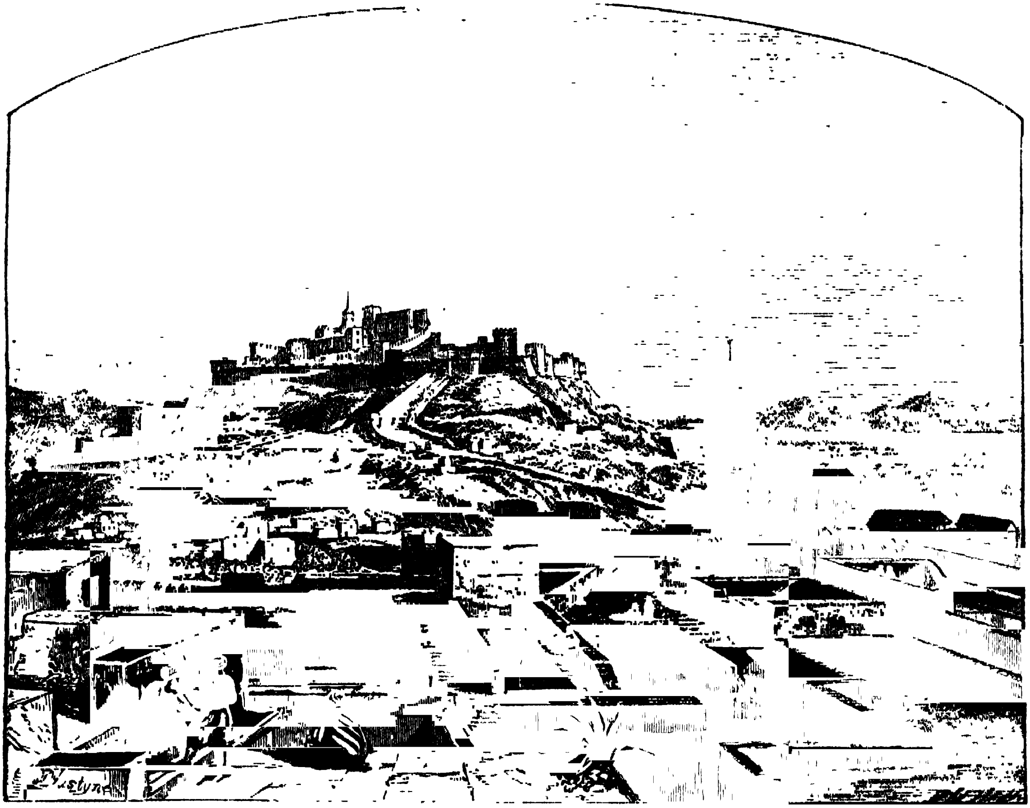
TAN'GENT is the name of the striking part of the oblong mediæval musical instrument called the clavichord, contemporary with the usually triangular or pentangular spinet. But while the spinet was played with quills which plucked the strings as they passed, the clavichord struck the strings by tangents. These were pins of brass fixed into the back of the key, and were about an inch long, beaten out at the top to form a head. As the back of the key rose when its front was struck by the player's finger, the tangent was driven against the brass string and set it into vibration. At the same time, by remaining pressed against the string it formed a node, and divided the string into two vibrating parts, one considerably longer than the other, and giving forth the sound of the note. All the strings were damped by a cloth strip run through them behind the row of tangents, and being

thus always damped were prevented from assisting the tone by sympathetic resonance. The notes of the black keys were produced upon the strings serving the white ones, their tangents striking those strings at such a point as to set a shorter part of the string vibrating. It was not till 1700 that every tangent had its proper string. The tone of the clavichord is weak, but admits of much expression.

TANGENT GALVANOMETER or **TANGENT COMPASS.** See VOLTAIC ELECTRICITY.

TAN'GHIN (*Tanghinia venenifera*) is a tree belonging to the order APOCYNACEÆ, confined to Madagascar. It is remarkable from the use made from time immemorial by the natives of the poisonous seed to establish the guilt or innocence of suspected persons. The fruit is a smooth purplish drupe, 2 or 3 inches long, containing a hard stone surrounded by a thick fibrous flesh. The kernel is pounded and a small piece placed on the tongue of the person subjected to this trial by ordeal, who is compelled to swallow it. Those in whom it excites vomiting quickly escape the effects of the poison, and are held to have established their innocence. Otherwise the poison is rapidly fatal, a result which is considered conclusive of guilt. The use of this terrible ordeal is dying away before the advances of civilization in Madagascar.

TANGIER', a town of Morocco, on the Straits of Gibraltar, of which fort it is 35 miles south-west. It is built on a hill, near a spacious bay, and has a beautiful appearance from the sea, but it is ill built, with narrow and bad streets, along which wheeled vehicles never pass, traffic being carried on by means of camels, mules, and donkeys. There are several Jewish synagogues, a mosque, and a Saracenic castle. The population is about 10,000. It is strongly defended on the sea, but not on the land side. The town being within an easy excursion distance from Gibraltar is often visited by English tourists. It



Tangier

derives some interest from the varieties of costume to be seen in its streets, and from the castle, seated on a rugged eminence, which commands a superb view of the Gibraltar rock, the vineyard-crowned knolls on the Spanish shore, and the intervening waters. It was a Portuguese possession in 1662, when it passed to England on the marriage of Charles II. with Catharine of Braganza, but was relinquished in 1684 on the ground of expense. It was captured in 1859 by the Spaniards; but, on payment of a considerable indemnity, it was restored to the Emperor of Morocco in the following year.

TANGLE is the common name given to two species of olive-coloured seaweeds [see ALGÆ], *Laminaria digitata* and *Laminaria saccharina*, abundant on the coasts of Britain. They grow attached to rocks in deep water, and are usually exposed only at low tides. They are of considerable size, with a thick stalk, and a leathery, flat, ribless frond. Tangles are largely used for the preparation of kelp as manure. They are also used for fuel and for feeding cattle, and the young stalks, which contain a large quantity of gelatinous matter, sometimes afford food to human beings.

TANJORE (*Tanjavur*), a British district in the Madras Presidency, with an area of 3654 square miles, and a population of 2,000,000. Tanjore forms a portion of the Southern Karnatic. It is bounded on the north by the

river Coleroon, which separates it from Trichinopoli and South Arcot districts; on the east and south-east by the Bay of Bengal; on the south-west by Madura district; and on the west by Madura and Trichinopoli districts and by the State of Pudukota. The coast line of the district extends for a distance of 170 miles; a heavy surf breaks incessantly on the shore, rendering communication with shipping very difficult and dangerous. The administrative headquarters are at Tanjore City, situated on the south bank of the Kaveri (Cauvery).

Tanjore has a just claim to be considered the garden of Southern India. The vast delta of the Kaveri occupies the flat northern part of the district, which is highly cultivated with rice, dotted over with groves of cocoa-nut trees, and densely populated.

Of the total area, about 53 per cent. are actually under the plough; 21 per cent., or 497,025 acres, are cultivable, but not cultivated (including land left fallow); and 26 per cent., or 631,044 acres, are uncultivable, or reserved for purposes other than agricultural. Of the cultivated area more than 90 per cent. are under food grains, and of these four-fifths are irrigated rice lands.

The great natural advantages of irrigation which Tanjore possesses had been more or less improved upon many centuries before the district became British territory. The Coleroon, which forms the northern boundary of Tanjore, is, from its low level, utilized but to a small extent. The main branch of the Kaveri (Cauvery) enters Tanjore district about 8 miles east of Trichinopoli, and spreading out into innumerable small channels, which form a vast network extending down to the sea, converts the northern portion of the district, commonly known as the Kaveri delta, into one huge rice-field. Near the western limit of Tanjore, the two main streams come into close contact with each other; and at this point, where the bed of the Coleroon is 9 or 10 feet lower, stands (across a natural outlet of the Kaveri channel) the ancient native work, a masonry dam, known as "The Grand Anicut," which prevents the waters of the Kaveri branch being wholly drawn off into the Coleroon. This work, which has been justly called the "bulwark of the fertility of Tanjore," is traditionally believed to have been constructed by a king of the Chola dynasty in the third century, A.D. There are grounds for conjecturing that it dates not later than the twelfth century.

Tanjore is more than ordinarily favoured by nature with regard to immunity from the calamities alike of flood and drought. The high ridges of sand which skirt its coast-line form an effective protection against ordinary storm waves; while the level of the country, which slopes towards the east, insures the free drainage of the surplus water of the Kaveri as well as of local rainfall, which is rarely very heavy.

The district is amply provided with the means of communication. It is traversed by two branches of the South Indian Railway; the one from Trichinopoli crossing the district to Negapatam on the coast, and the other (Madras branch) branching off from this line at Tanjore City and running in a north-easterly direction. Including the cross lines of internal communication, but excluding the innumerable village tracts, the district contains 70 roads, aggregating nearly 1200 miles in length, most of which are provided with substantial masonry bridges over the rivers by which they are intersected, as well as culverts for smaller channels. There is but one navigation canal in use, running 32 miles along the coast from Negapatam to Vedaranyam in the south. It is used almost exclusively for the carriage of salt, which is produced in abundance at Vedaranyam. The manufactures for which Tanjore district is celebrated are metal wares, silk cloths, carpets, and pith-work. The chief articles of import are cotton piece-goods, twist and yarn, and metals from Europe, and timber and betel-nuts from the Straits Settlements and Ceylon. Rice is by far the most important article of export, alike by sea and land. By sea, it is exported almost wholly to Ceylon; inland, to Trichinopoli, Madura, and Salem.

The modern history of Tanjore commences with its occupation by the Marhattas in 1678 under Venkaji, the brother of Sivaji the Great, and the founder of the line of Tanjore rajahs. The British first came into contact with Tanjore by their expedition in 1749, with a view to the restoration of a deposed rajah. The cession of Devikota was promised as the reward of their aid. They failed in this attempt, and a subsequent expedition was bought off. Subsequently, the famous Muhammad Ali, Nawab of Arcot, was aided by the Madras government in enforcing a claim for tribute against the Tanjore dynasty, and the fort fell into the hands of the invaders on the 16th September, 1773. In 1775 it was restored to the Tanjore prince, Tulzuji. Practically, until 1779 the Marhattas held the Tanjore State, first as tributaries of the Mogul Empire, then of the Nawab of the Karnatic Payanghat, then as independent sovereigns; and lastly, under the English East India Company, as assignees of the nawab's tribute. During the latter end of the last century, Tanjore was in fact a protected State of the British Empire, paying its share of the subsidy for the army, which the latter maintained for the defence of the country. It was ceded to the company in absolute sovereignty by Rajah Sharabhoji, under treaty dated 25th October, 1799.

TANJORE CITY, the headquarters of the collector, the judge, and the other departments of district administration, has 55,000 inhabitants. It was the last capital of the ancient Hindu dynasty of the Cholas, and was subsequently ruled by a Nayak governor from Vijayanagar. Between 1656 and 1675, it fell into the hands of the Marhattas, under whose rule it became the capital of a compact and prosperous state. In 1758 it was attacked by the French under Lally, who extorted large sums from the reigning Marhatta rajah. Colonel Joseph Smith captured the fort in 1773; and again, in 1776, it was occupied by an English garrison. Rajah Sharabhoji, by a treaty in 1779, ceded the dependent territory to the British, retaining only the capital and a small tract of country around, which also at last lapsed to the government in 1855, on the death of Rajah Sivaji, son of Rajah Sharabhoji, without legitimate male issue.

As the capital of one of the greatest of the ancient Hindu dynasties of Southern India, and in all ages one of the chief political, literary, and religious centres of the south, the city of Tanjore is full of interesting associations. Its monuments of Hindu art and early civilization are of the first importance. The great temple is known throughout the world. Fergusson, in his "History of Indian and Eastern Architecture," says of it: "The great pagoda was commenced on a well-defined and stately plan, which was persevered in till completion. . . . It consists of two courts, one a square of about 250 feet, originally devoted to minor shrines and residences; but when the temple was fortified by the French in 1777, it was converted into an arsenal, and has not been reappropriated to sacred purposes. The temple itself stands in a courtyard extremely well proportioned to receive it, being about 500 feet long by half that in width, the distance between the gateway and the temple being broken by the shrine of the bull Nandi, which is sufficiently important for its purpose, but not so much so as to interfere with the effect of the great *vimana*, which stands near the inner end of the court. The perpendicular part of its base measures 82 feet square, and is two storeys in height, of simple outline, but sufficiently relieved by niches and pilasters. Above this the pyramid rises in thirteen storeys

to the summit, which is crowned by a dome said to consist of a single stone, and reaching a height of 190 feet. The porch in front is kept low, and the tower dominates over the *gopuras* and surrounding objects in a manner that imparts great dignity to the whole composition."

The fort, which is now almost dismantled, covers a large area. Within it is the chief part of the native town, and the palace, which is still occupied by the family of the last rajah. There are some fine halls in the palace, which also contains the large and valuable library that belonged to the rajah, with some unique manuscripts catalogued by Dr. Burnell of the Madras Civil Service.

Tanjore is famous for its artistic manufactures, including silk carpets, jewelry, *répoussé* work, copper wares, and curious models in pith and other materials. The South Indian Railway connects Tanjore with Negapatam (its seaport) on the east, and Trichinopoli on the west.

TANK'ARD, a word of uncertain origin beyond Old French, where it is first found (Rabelais has *tanquard*): perhaps it may come from the Greek *kantharos*, goblet. As we know it, the word is applied to a drinking vessel with a cover; and an absurd piece of folk-etymology, which would derive it from *étain* (tin) and *quart*, shows that it has always been of large size. The Flemish wooden tankards with pegs down the sides, so that the successive drinkers might measure the depth of their potations, are one amusing variety of the tankard.

TAN'NAHILL, ROBERT, a Scottish poet, was born at Paisley, 3rd June, 1774, and was the fourth son of a weaver of silk gauze in that town. On leaving school he was apprenticed to the weaving trade, which was then in a most prosperous state, and it was his custom while at work to compose verses, and jot them down on a writing desk attached to his loom. With the exception of two years spent in Bolton, in England, the whole of the remainder of his life was spent in Paisley and in the routine of his craft. In 1807 he published a volume of verse which was very favourably received, but the celebrity he obtained acted injuriously upon his health and circumstances, and after a prolonged period of depression he committed suicide by drowning himself in a canal in the vicinity of Paisley, 17th May, 1810, he being then at the age of thirty-six.

As a poet his taste had been formed by the study of Allan Ramsay, Fergusson, and Burns, and his songs are characterized by simplicity, tenderness, and genuine pathos, as well as by much ease and sweetness of versification. His "Jessie the Flower o' Dunblane," "The Braes o' Gleniffer," "Thou Bonnie Wood o' Craigielea," "The Braes of Balquhither," and one or two other lyrics, have obtained a permanent place among the treasures of Scottish song. There have been several editions of his works, one of the best, accompanied by a memoir, being published at Paisley in 1874.

TANNER, THOMAS, was born at Market Lavington, Wiltshire, 25th January, 1674. In November, 1689, he was entered a student of Queen's College, Oxford; but after taking his degree of B.A. he removed in January, 1694, to All Souls, and was elected a fellow of that society, 6th November, 1696. Anthony à Wood, at his death in 1695, left his papers to Tanner's care. In the same year Tanner published at London his first work, an octavo volume entitled "Notitia Monastica, or a Short Account of the Religious Houses in England and Wales." He was now appointed by Dr. Moore, bishop of Norwich, one of his chaplains; and having in 1701 married the eldest daughter of that prelate, he received various preferments. In 1706 his wife died, and in that year he was presented by a friend to the rectory of Thorp, near Norwich. His next publication, a new edition of Wood's "Athenæ Oxonienses," enlarged with 500 new lives from Wood's manuscripts, appeared at London in two vols. folio, in 1721. In December of that year Tanner, who had taken his degree of D.D. in 1710, was appointed to the archdeaconry of Norfolk, and in 1723 became canon of Christ's Church, Oxford. He was consecrated to the bishopric of St. Asaph in January, 1732; and died at Oxford, 14th December, 1735. His literary reputation rests principally on his great biographical and bibliographical work, entitled "Bibliotheca Brittannico-Hibernica," which had been the labour of his leisure for forty years, and which was published in folio at London, in 1748, under the care of the Rev. Dr. David Wilkins.

TANN'HAUSER (Ger. *Ritter Tannhaüser*), a celebrated legendary hero of Germany, and the subject of a popular ancient ballad. He was a knight of great valour, devoted to beautiful women; and fired by the tales and counsels of a learned philosopher of Mantua, named Hilario, desired to obtain the love of some fair spirit, who for his sake should condescend to assume a mortal body. He therefore ventured to ascend the enchanted mountain, Venusberg, and penetrated into the magic cave where the Lady Venus held her seductive court. Among its sinful pleasures he lingered long; but conscience at length awakened, and the repentant knight set forth on a pilgrimage to Rome, where he publicly confessed his sins before Pope Urban. Absolution, however, was refused to him. It was as impossible for him to be pardoned, said the Pope, as for the dry wand which he held to sprout and put forth green leaves again. In an agony of despair Tannhaüser quitted Rome, and Venus succeeded in beguiling him back to the mountain, where he will remain until the Last Day. Meanwhile, the dry wand blossomed; and the Pope, alarmed by the miracle, sent messengers everywhere in search of the unhappy knight, but he could not be discovered. Such, in brief, is the popular legend, which is probably not much older than the early part of the fourteenth century, and seems to have been embroidered upon the actual life of a knight, named Tannhaüser, a contemporary of Pope Urban (1261–65), a wandering adventurer, and a lyrical poet of genius. The esoteric meaning of the story is doubtful, but it has evidently a connection with the old fables of Calypso and Circe. It has been embodied by Tieck in his "Phantasies," and made the subject of a fine opera by Richard Wagner In the latter the soul of the sinning but repentant knight is saved by the prayers of a stainless maiden.

TANNIC ACID and **TANNIN** are vegetable substances found in the bark of certain trees, in the gall-nut or oak-apple of the common oak, and in other plants. The tannins are generally amorphous, with slight acid reaction, and are particularly remarkable for their uniting with animal membrane, and forming a tough substance which resists putrefaction and is known as leather—the process known as the tanning of skins. Many varieties of tannin have distinctive characteristics, but these may be generally divided into two groups, those which give blue or black precipitates with ferric salts, and those in which the precipitate is olive-green. The former have been shown by Stenhouse to be glucosides, whereas the latter, with one exception (that from willow bark), are not.

The best known of the former is gallotannic acid, or the tannin employed in medicine; it is obtained from finely-powdered gall-nuts by percolation with ether. The ether separates into two layers, the lower of which is a syrupy solution of tannic acid; this is carefully evaporated *in vacuo*. Gall-nuts yield 35 to 40 per cent. of tannic acid. Thus prepared, it is an inodorous, colourless, amorphous mass, very soluble in water, and with a strongly astringent, but not bitter, taste. It becomes yellow on exposure to light. The formula is $C_{27}H_{22}O_{17}$. It is soluble in acetone, in glycerin, and in several oils both fixed and volatile. When carefully heated it is decomposed into

carbonic acid, pyrogallic acid, which volatilizes, and metagallic acid, which remains.

$$\underset{\text{Gallotann acid.}}{C_{27}H_{22}O_{17}} = \underset{\text{Pyrogallic acid.}}{3C_6H_6O_3} + \underset{\text{Metagallic acid.}}{C_6H_4O_2} + 3CO_2$$

Boiled with a dilute acid it splits up into glucose and gallic acid.

$$C_{27}H_{22}O_{17} + 4H_2O = \underset{\text{Glucose.}}{C_6H_{12}O_6} + \underset{\text{Gallic acid.}}{3C_7H_6O_8}$$

Gallotannic acid is precipitated from solution by mineral acids as a gelatinous mass. It gives a black precipitate with ferric salts, and a white precipitate with tartar emetic and also with gelatin. It can be entirely removed from solution by immersing in it a piece of skin, and the amount present may be estimated by the increase of weight of the skin. This process is often employed in commerce to test the value of tanning materials. Gallotannic acid forms white precipitates with most of the alkaloids, and is useful as a reagent generally. It is tribasic, and gives three varieties of salts with bases—neutral, acid, and basic; but all are unstable, and oxidize when exposed to the air. The general formula of the neutral salts is $C_{27}H_{19}M_3O_{17}$. It is much employed as a mordant in calico printing, and in medicine as a powerful astringent; externally in solution in glycerin, and internally in doses of 2 to 10 grains. The most important of the other varieties of tannin are catechu tannic acid from catechu, morin-tannic acid from fustic, querci-tannic acid from oak bark, and quino-tannic acid from Peruvian bark.

When gallotannic acid is boiled with potash another acid is produced called tannomelanic acid, having the formula $C_6H_4O_3$. Tannoxylic acid, or rufitannic acid is obtained by the oxidation of gallic acid. The formula is $C_7H_4O_6$. It is a red amorphous powder.

TANNING. See LEATHER.

TAN'SY (Tanacetum) is a genus of plants belonging to the order COMPOSITÆ, suborder Corymbiferæ, and allied to the genus ARTEMISIA both in characters and properties. The Common Tansy (*Tanacetum vulgare*) is abundant in Great Britain and throughout Europe, on the borders of fields and roadsides. It is an erect perennial herb, growing from 2 to 3 feet high, with deep green bipinnatifid leaves, having the leaflets deeply cut, and with terminal corymbs of hemispherical flower-heads, the florets of which are golden yellow. Long cultivated in English gardens, it has also been naturalized in many parts of North America. The leaves are often used for flavouring puddings, cakes, and omelets; but are of a strong aromatic smell, and of a disagreeably bitter taste. Tansy was formerly much used in medicine as a tonic and anthelmintic; and tansy wine is still esteemed by country people as a stomachic. From Chambers' "Book of Days" we learn that anciently "both ecclesiastics and laics used to play at ball in the churches for tansy cakes at Eastertide; and though the profane part of this custom is happily everywhere discontinued, tansy cakes and tansy puddings are still favourite dishes at Easter in many parts." Tansy, says Selden, in his "Table-Talk," was taken from the bitter herbs in use among the Jews at this season. "Our meats and sports," he says, "have much of them relation to church works. The coffin of our Christmas pies, in shape long, is in imitation of the cratch or manger wherein Christ was laid. Our tansies at Easter have reference to the bitter herbs, though at the same time 'twas always the fashion for a man to have a gammon of bacon to show he was no Jew."

Coles, in his "Art of Simpling," describes a peculiar property to this popular plant. "If maids will take wild tansey, and lay it to soake in buttermilke nine days, and wash their faces therewith, it will make them looke very faire."

TAN'TALOS is represented by some authorities as a son of Zeus. He married Euryanassa, by whom he had Pelops, Broteas, and Niobê. He was king of Phrygia. Admitted to the banquet table of his omnipotent father, he had the imprudence to divulge the divine counsels, and was punished by being placed in the midst of a lake, under branches loaded with fruit; but as soon as he attempted to drink, the waters receded from him, and when he would have eaten, the fruit vanished from his grasp, while over his head impended a huge rock constantly threatening him with destruction. Another version accounts for his punishment in a different manner; he had served up to the gods at a banquet the body of his son Pelops, to test their supernatural wisdom. Zeus discovered the crime the moment his attention was given to the feast, but Dêmêtêr had already begun her meal off the horrid feast, and had eaten part of the shoulder. Zeus at once restored Pelops to life, and replaced the flesh of the missing shoulder by ivory. Tantalos was hurled into Tartaros. Pindar, however, gives yet a third vesion; and affirms that he stole the celestial nectar and ambrosia, and distributed them among men. In this we see the story of Promêtheus in a different form, and recognize the idea of the benefits which the sun procures from the sky to lavish upon earth. His presence at the banquets of Zeus in like manner, symbolizes the "daily visits of Hêlios to the dizzy heights of heaven." The murder of Pelops refers, perhaps, to the scorching heat of the sun, which destroys the vegetation brought into being in the first place by its genial influence, and afterwards offered up, dead and decayed, to the eyes of Zeus (or the sky). His punishments are equally allegorical. He looks on the fruits of the earth and the bright waters of the lake, but cannot devour them; his breath withers the fruit, and dries up the waters. The rock is an emblem of the thunder cloud, "which gathers into the shape of mountains, and remains motionless in the sky until its wrath breaks forth in the storm."

The doom of Tantalos, which has given rise to the verb *tantalize*, may be compared with the misfortune of Orpheus, when he turns too quickly to embrace Eurydikê. The name of his wife, Euryanassa, the wide-reaching princess, denotes the broad radiance which overspreads the sky at early morning.

TAN'TALUM. This is a rare metal, discovered in 1802 by Elseberg, in tantalite. It occurs as a tantalate of iron and manganese in several minerals, and in yttrotantalite as a tantalate of yttrium. The pure metal is obtained by heating the fluo-tantalate of sodium with metallic sodium, and washing out the sodium salts. It is a black powder, having a specific gravity of 10·78. The atomic weight is 182, the symbol Ta. It is a good conductor of electricity. Heated in the air it burns brightly, and is converted into tantalic oxide. It is insoluble in all the mineral acids, except hydrofluoric acid, in which it is freely soluble. It forms two oxides, the dioxide or tantalous oxide (TaO_2), and the pentoxide or tantalic oxide (Ta_2O_5). Tantalous oxide is a hard gray substance which scratches glass; by heating to redness in the air it is converted into tantalic oxide. This is a white powder of specific gravity 7·61, and insoluble in all acids. It is rendered soluble by fusing with potassium hydrate, which forms tantalate of potassium. From the solution of this salt the hydrated tantalic oxide or tantalic acid may be precipitated by the addition of hydrochloric acid. It is a white bulky powder, soluble in hydrochloric and hydrofluoric acids. There are two varieties of tantalates; the native insoluble compounds have the formula $MOTa_2O_5$, the soluble and crystallizable salts having the formula $4M_2O,3Ta_2O_5$. The chloride of tantalum, or tantalic chloride ($TaCl_5$) is a yellow substance which volatilizes and melts to a yellow liquid at 221° C. (430° Fahr.)

Bromide of tantalum ($TaBr_5$) resembles the chloride.

The fluoride, TaF_5, forms double salts with the alkalies, called fluo-tantalates. These salts are very soluble and crystalline. The formula of the potassium salt is K_2TaF_7. Tantalum is distinguished from other metals by the great insolubility of its oxide, and by the blue colour produced by metallic zinc in the solution of tantalic chloride.

TAN'TALUS. See WOOD IBIS.

TAN'TUM ER'GO, a hymn of the Roman Catholic Church. *Tantum ergo* are the first words of the last two stanzas of the hymn

> "Pange lingua gloriosi
> Corporis mysterium," &c.,

written by St. Thomas Aquinas for the festival of Corpus Christi, and not to be mistaken for the much better known Holy-Week Hymn,

> "Pange lingua gloriosi
> Lauream certaminis," &c.

The *Tantum Ergo* stanzas are as follows:—

> "Tantum ergo Sacramentum, Veneremur cernui
> Et antiquum documentum Novo cedat ritui
> Præstat fides supplementum, Sensuum defectui.
>
> "Genitori, genitoque, Laus et jubilatio
> Salus, honor, virtus quoque, Sit et benedictio
> Procedenti ab utroque Compar sit laudatio."

They are sung in the Roman Catholic Church whenever the host is carried in procession, at the Office of Benediction, &c., and having in this way become specially connected with the host, they are never sung but in its presence. A peculiar sanctity therefore attaches to them, and the greatest musical composers have lavished the resources of their art upon them; Mozart has left us two famous orchestral settings, always regarded as the finest we have, and Schubert wrote three. Besides these grand compositions, fitted only for festival services, the daily use of the *Tantum ergo* at Benediction has called forth a host of minor settings.

TA'OISM, one of the three religious systems recognized by the Chinese government, the others being Confucianism and Buddhism. The name is taken from the famous treatise entitled "Tao Teh King," written by Lao-Tsze in the sixth century B.C., but there is no clear historical connection between this famous philosopher and the system of Taoism. As early as the third century B.C., however, Taoism was the name given to a system of gross superstition which included most of the ideas comprised in alchemy astrology, the search for the elixir of life, and also a mysterious doctrine of the possible sublimation of the body. At a later period, probably about the beginning of the Christian era, the system found an energetic leader in Chang-tao-ling, who became a sort of pope or patriarch, and it is said that the office has continued in line of his descendants down to the present day. The system at a later period borrowed many ideas from the rival systems of Buddhism and Confucianism, retaining, however, its own peculiar superstitions, which so far as its devotees are concerned have ever formed its chief attraction. Despised by the educated Chinese, it draws most of its votaries today from the poor and ignorant classes of the empire. See also CHINA and LAO-TSZE.

TAPAYAX'IN (*Phrynosoma orbiculare*) is a species of LIZARD belonging to the family Agamidæ. This lizard is a native of the mountainous parts of Central Mexico. It has a short, oval, flat toad-like body, with a very short square head, rounded in front, and a short pointed tail. There are eight sharp radiating spines on the back of the head, rows of spiny scales on the flanks, and scattered spines on the back. The limbs are very short. The upper surface is of a dull sand colour spotted with brown, and the head is reddish-brown, yellowish beneath, with brown spots. The total length is about 6 inches. It appears to live on insects, and to be very sluggish in its habits. An allied species, *Phrynosoma cornutum*, is a native of Texas.

TAP'ESTRY (Fr. *tapisserie*), a variety of textile fabric used for the ornamentation of walls, for curtains and screens, and for the decoration of furniture. The definition of tapestry as distinguished from weaving of other kinds is that while by means of coloured threads interwoven as a woof with a series of fixed threads standing as a warp, the weaver forms one web, he so varies his colours as that this web shall represent objects pictorially, so that his art is a kind of painting in textile fabrics. Tapestry, moreover, is sharply cut off from embroidery by this definition; for the pictures of tapestry are a part of the web, while those of embroidery, on the other hand, are worked upon a web already formed. A further characteristic of tapestry is that it is always hand work, and can never be woven, for it admits of no repetition of designs, except sometimes in borderings.

Nevertheless, the term is laxly used, as witness the far-famed Bayeux Tapestry, which, as stated in our article on the subject, is not tapestry at all, but embroidery. The art of working tapestry is extremely ancient, and fabrics of wonderful richness and elaboration were made in Assyria, in Babylon, in Egypt, in India and China, and in Greece and ancient Italy. Homer, Virgil, Catullus, and Ovid describe the advanced subjects treated in this way, portraits, mythical scenes, and inscriptions. The mantle of Alkisthenes, into which were woven portraits of the gods of Greece and of the artist, sold to the Carthaginians by Dionysius the Elder of Syracuse, fetched £26,500 of our money (120 talents). And as to Rome, Nero caused a velarium of tapestry, representing Apollo in his chariot, to be stretched across the great space of the amphitheatre. In the Old Testament we find the curtains of the tabernacle are perhaps a form of tapestry: "and he made the veil of blue, and purple, and scarlet, and fine twined linen, with cherubim; the work of the cunning workmen made he it" (Exod. xxxvi. 35). But the passage is held by the best authorities to indicate rather embroidery than tapestry. In Europe the art appears with many others to have fallen into decay during the dark ages, its forms being degraded, and its colours giving way to splendid and brilliant embroidery for the countless hangings then used. After contact with the East was renewed by the Crusades true tapestry revived and subsequently attained a high degree of development. At first tapestry was chiefly used for the decoration of cathedrals, churches, and other ecclesiastical edifices, the work being extensively carried on in connection with monastic establishments, but later it was introduced into the palaces of the kings and the homes of persons of rank and wealth. During the mediæval period, English embroidery enjoyed a high reputation throughout Europe, while the manufacture of true tapestry was carried to such perfection in the city of ARRAS that the name of the city was for a long time synonymous with that of the material itself. (The Italian name for tapestry even now is *Arazzi*, the Spanish *Panos de raz*.) After the fourteenth century pictorial backgrounds were introduced into tapestries. Arras still continued, by the long protection of the great dukes of Burgundy, to head the art of tapestry during the fifteenth century. From 1423 to 1467 there were fifty-nine master tapestry workers holding factories in the town and in constant work. All this flourishing industry was struck down by the capture of the town at the hands of Louis XI. in 1477, and the banishment of its patriotic inhabitants a few years later. When therefore it is stated that the Raffaello tapestries were woven at Arras, a great anachronism is perpetrated, for the looms of Arras had been silent many long years before, and only one or two scantily fed workshops remained. Brussels, Bruges, Ypres, and other Flemish towns also competed with Arras in the fine times of the Burgundian supremacy.

Consequent upon the downfall of Arras tapestry, at the close of the fifteenth century, Italy was flooded with crowds of the fugitive weavers; and very quickly the sixteenth century saw the great Italian art-loving cities developing centres of tapestry weaving which competed fairly with those of Flanders. But the short-sighted policy of the art-patrons of Italy weighed too heavily on the new art. Led by the ancient Flemish supremacy, the nobles, notably Pope Leo X., sent cartoons to Flanders to be woven. Italy held the monopoly of design at this time, and Brussels of manufacture. The Italian tapestry workshops declined one after the other. Cartoons were sent to Brussels by the greatest artists of the Renaissance; thirty-six workshops were busy in 1544. Mantegna, Lionardo da Vinci, and later on Giulio Romano, drew cartoons for Brussels tapestry, and of these famous Italian tapestry cartoons, those of Raffaelle, drawn for the Sistine Chapel tapestries, and which have been carefully preserved, being, though by no means the best adapted for their purpose, by far the most celebrated. [See CARTOON.] They were woven at Brussels, and took from 1515 to 1519. Each one cost £200 for the design, and £30,000 for the weaving, including gold thread, a costly item. These famous hangings were pawned for 5000 ducats at the death of the Pope, whose extravagances in the cause of art had ruined the treasury. Thus removed from due care, they fell into the hands of the soldiery at the sack of Rome in 1527, and many were stolen; one was even wantonly destroyed. Two drifted as far as Constantinople, others elsewhere. With infinite pains the Constable de Montmorency recovered the whole. When the troops of the French Directory occupied Rome at the close of the eighteenth century a syndicate bought up the hangings and exhibited them in Paris; but Pius VII. prevailed upon Napoleon in the subsequent days of the empire to restore them to Rome, where they now adorn a splendid gallery in the Vatican. (They are, however, unfortunately stretched flat instead of hanging in folds.) Many duplicate sets were made, and those made for Madrid, Berlin, Mantua (now at Vienna), and the cathedral of Loreto are still preserved there.

In 1535 Francis I. revived the art in France, and engaged the Flemish artists, then the best in Europe, to instruct the French workers at Fontainebleau. The art now received an enormous impetus from the genius of Rubens, who designed that magnificent series of the history of Marie de Medicis, which is a great ornament of the Louvre, besides many other splendid series. Following him, two generations later, came Le Brun, who, though not a great painter, was perhaps the greatest tapestry designer who ever lived, his art being thoroughly in sympathy with the weaver's best effects and truest needs. These, with Jordaens, Teniers, De Champagne, Poussin, Lesueur, &c., brought up a grand revival of the art, which now touched its acme of pomp and splendour. The rise of Parisian tapestry is due largely to Henri Quatre, who installed several looms in the Faubourg St. Antoine in 1597, and removed them to the Louvre in 1603. A second establishment for Flemings followed in 1607; and a third for carpets, which developed into the Savonnerie, completed the series. (At Henri's death the tapestry workers were somewhat scattered; some of them found their way to the manufactory of the Gobelins, already famous for its dyeing and weaving.) This epoch saw also the creation of the English works at Mortlake, started by James I. in 1619, with a yearly subsidy of £2000, the first workers being all Flemings. For a long time this famous workshop had no real rival but the Gobelins; Rubens and Van Dyck painted for it. One of its greatest efforts was the weaving of a complete set of the Raffaelle cartoons, now in the National Garde-Meuble, Paris. Mortlake ceased during the Commonwealth, but was revived with vigour under Charles II. It did not probably exist beyond 1688. Colbert, the celebrated minister of Louis XIV., induced his royal master to extend the patronage of the state, to form a state tapestry establishment out of the already celebrated establishment of the GOBELINS in 1662; the designs being the sole charge of the great Le Brun. Here the art has perhaps attained the highest degree of perfection yet achieved. In 1664 a large subsidy assisted to found the famous tapestry establishment at Beauvais, and the same period saw the carpet weaving of the Savonnerie brought to the level of a state workshop. All of these still continue, and were allowed to exist even all through the great Revolution. Latterly the manufacture of tapestry has been revived in England under royal patronage, and the Windsor factories have produced some very choice and beautiful pieces of tapestry, only high-class work being attempted. In tapestry work a series of white cotton (formerly either woollen or silk) threads are arranged vertically in a frame like the warp of a loom; but the woof, instead of being carried from one end to the other, as in ordinary weaving, is introduced from the back by means of spindles of wool or silk of the shades required, and crossing few or many of the threads of the warp according to the amount of colour needed, the threads of the woof being fastened behind. In this way the most elaborate designs in outline and colour can be copied so closely that the yarn reproduces almost the effects of ordinary oil painting, and but little difference can be detected by the eye between the finished work and the coloured drawing from which it was copied. In another method the threads of the warp are stretched on a frame which is laid horizontally over the copy, and the worker weaving from the reverse side covers so much of the fabric as the pattern indicates with each colour. The two methods are known respectively as high warp and low warp, the latter being considered greatly inferior to the former, partly because the workman cannot judge of the effect from the right side, and partly because he can only see the copy dimly through the warp threads. It is, however, a less costly and vastly quicker system than that of the high warp, for treadles are used and both hands are free for the shuttles, and it is employed for work of lower price and inferior quality. Only low warp looms are used at Beauvais, and only high warp at the Gobelins. The weaver not only works from behind in the high warp loom, as he does also in the low warp, but in high warp his model is placed behind him, so that he has to turn every instant to see it. In consequence of this, and because of the infinite care with which the mixture and gradation of tints is followed, a first class worker at the Gobelin rarely produces more than 28 square centimetres of finished work a day, that is, roughly speaking, a square yard a year, his wages being about £80 to £100 for that time. In addition to this there is the cost of the material and the expensive dyeing and experimenting department. Chevreul, the chemist, was associated with the latter from 1871 onwards.

In commerce the name tapestry is given to carpets and curtains produced by ordinary weaving, but which, except for the multiplicity of colours employed, have no connection with true tapestry at all. Tapestry stretched on a frame is spoilt; it is aping the art of the painter, and losing its own especial charm. A great wrong is often done to this truly royal species of art-work in the way it is displayed in our collections and exhibitions. It should be used and shown always as drapery, whether serving for wall hangings or door hangings, or curtains, &c.; so that as it waves with the movement of air or the touch of a dress it presents subtle variations of forms of matchless charm. As hanging work it is altogether unequalled. Its colours should be brilliant and varied, its forms bold and well defined, its space well filled without being crowded. It is said that at the Gobelins they have now 14,000 shades of colour; but the old work, with less than a hundred tints, was quite as good,

for over-subtlety degenerates into mere imitation of the picture which the tapestry weaver has for his model, while the true artist aims rather at a translation into tapestry than an imitation. If the latter were the object aimed at it would be better attained by painting a cloth than by weaving a tapestry.

The best concise history and description of tapestry is that contained in Eugène Muntz's "Short History of Tapestry" (English translation, London, 1885). The South Kensington "Handbook on Tapestry," translated and largely abridged in 1878 from Champeaux' work, is also very succinct and useful.

TAPEWORM is the common name of the species of Cestoidea, an order of the class PLATYHELMINTHA. The tapeworms are parasitic flat worms, inhabiting different hosts at different stages of their life-history, but infesting chiefly vertebrate animals. They are always internal parasites, and exhibit great degeneration in accordance with this dependent life. They have no trace of a mouth, alimentary canal, or vascular system. There are only slight traces of a nervous system, and no special organs of sense. They are hermaphrodite, and the generative system displays great complexity, an enormous number of eggs being produced. They are occasionally unisegmental, but generally form by budding a long chain, thus giving rise to what may be regarded as a colony of individual zooids or persons, comparable to the colonies of the Hydrozoa.

The Common Tapeworm (*Tænia solium*), as the best known species, may be taken as typical of the whole group. This species is parasitic in the adult condition in the alimentary canal of man, and passes its larval stages in the muscles of the pig. The adult tapeworm has a long, flat, many-jointed body, composed of 800 or more segments, the size of which increases gradually downwards. The whole body is from 10 to 30 feet long, and about a third of an inch broad at the widest part. It is attached to the walls of the intestine by the head, which is globular and about the size of a pin's head. The head has four powerful suckers, in front of which is a conical proboscis armed with a crown of hooks. The segments of the body, or *proglottides*, when ripe, break off from the chain, and are discharged from the bowels. The proglottis, which contains many thousand eggs, retains its vitality when liberated from the host's body, and creeps on to stalks of grass, leaves, &c., or falls into water. The eggs are then set free and swallowed by a pig, either together with its food or in water. For their development it is essential that they should be swallowed by a pig, or in certain rare cases by man himself. The egg is carried into the stomach, and the tough chitinous egg-shell being dissolved, gives exit to the embryo or *proscolex*, which is about $\frac{1}{1000}$ inch in diameter, globular in shape, with six scattered hooks on the anterior extremity. The proscolex burrows with its hooks through the wall of the stomach, working its way through the tissues till it gets into a bloodvessel, when it is carried on by the flow of the blood until it gets stopped, generally in the finest bloodvessels of the muscles. In this situation it begins to absorb nourishment and to enlarge, forming vesicles or cysts in the muscles, giving rise to the condition in the pig's body known as *measled*. The cyst, *scolex* or *hydatid*, grows to the size of a pea, and begins to bud inwards, producing the *tænia-head* or *strobila* with its crown of hooks and suckers. The further development of the tapeworm is checked until its migration into its final host, and this is accomplished by man eating raw or imperfectly cooked measled pork. In this case the tapeworm is carried into the human intestines, when the cyst is absorbed, and the tænia-head attaches itself to the wall of the intestine and begins to segment, forming a linear colony of sexually mature individuals. Each of these segments contain both male and female organs, and union may take place between the several individuals of the colony, though true self-fertilization does not occur. The genital pore, into which both male and female organs open, is on alternate sides throughout the body. There is also a nephridial or excretory system of tubes running through each segment, and opening in the middle line by a single pore at the last segment. As segmentation goes on continually from the back part of the head, the oldest segments are those at the tail, and these as they become ripe break off from the chain. In some cases, though rarely, the hydatid is developed within the human body, the eggs escaping from the mature segments before expulsion from the bowels. This leads to serious consequences, for though the final stages of the development of the tapeworm in man are comparatively harmless, the passage of the embryo through the tissues and the presence of the hydatid in some organ, such as the brain, the eye, or the liver, may produce fatal results.

The Beef Tapeworm (*Tænia mediocanellata*) differs from the common species in having no crown of hooks on the tænia-head, which is rather larger, truncated, and furnished with very large suckers. The intermediate host is the ox, and the final host man.

Another species, *Tænia echinococcus*, occurs in the immature state in man, and becomes sexually mature in the dog. The tænia-head, which has two rows of suckers, is about one-fourth of an inch in length, and produces only three segments, the last of which is continually falling away, containing several thousand eggs. The eggs getting into the human body liberate the six-hooked embryos, which bore their way through the tissues and frequently get into the liver or into other organs, where they become transformed into scolices or hydatids. These hydatids become very large, and produce by internal budding a great number of tænia-heads, which drop off and float in the liquid of the cavity of the hydatid, but do not attain sexual maturity as long as they remain within the human body. These hydatids are more dangerous than any other species of tapeworm which infests man, and a large number of deaths in Iceland are annually due to its presence. They have also been found in monkeys, horses, &c.

Several other species of Tænia have been found in rare cases infesting man in their final stages.

The tapeworm, which causes the "staggers" of sheep, occurring in the brain, is the cyst or hydatid of *Tænia cænurus*, which finds its final host in the dog. In the same way another of the dog's parasites, *Tænia serrata*, forms in its immature or hydatid condition the pea-measle of the rabbit. The cat is also infested by a species of tapeworm, *Tænia crassicollia*, which passes its first stages in the mouse.

The Broad Tapeworm (*Bothriocephalus latus*) is a large tapeworm which is occasionally found in the human intestine. It is very rare in this country, but is commoner in parts of Europe. It attains a length of from 25 to 75 feet, a width of one inch, and may have as many as 4000 segments. It is distinguished by its spoon-shaped head with lateral grooves, and by the genital pore being in the middle of each segment instead of at the side, as in Tænia. The eggs hatch as ciliated embryos, the cilia being shed when the embryo gets into the intestines.

There is a species of tapeworm found in the carp and other fishes which is remarkable for being unisegmental; it belongs to the genus Caryophyllæus. The body consists of an expanded mobile head and one segment, which carries the reproductive organs, the genital pore opening in the middle of the body. The eggs are swallowed by a species of river-worm (Tubifex), into the body-cavity of which the embryos escape, and give rise to the head by budding.

TAPIO'CA is a farinaceous substance prepared in South America from the roots of the bitter CASSAVA or MANDIOC (*Manihot utilissima*). This plant contains a poisonous principle, which is easily dissipated or decom-

posed by heat or fermentation; hence the flour becomes perfectly wholesome in the process of baking the cassava bread. The fecula, or flour, after the juice has been carefully expressed, is washed, and dried in the air without heat. This constitutes the Brazilian arrow-root of English commerce. When this fecula is prepared by drying on hot plates it becomes granular, and is called *tapioca*. It occurs in irregular lumps or grains, is insipid, inodorous, only slightly soluble in cold water, but entirely soluble in boiling water, forming a translucent and highly nutritious jelly. It is used in a similar manner to sago and arrow-root, and for making puddings. Tapioca formerly paid a customs duty of 4½*d.* per cwt., but this was repealed in 1869. The quantity imported is about 90,000 cwts. annually. See CASSAVA and MANDIOC.

TA'PIR (Tapiridæ) is a family of mammals belonging to the order UNGULATA, suborder PERISSODACTYLA, and containing a single genus, Tapirus. Only three living species of tapirs are known, having a very remarkable geographical distribution, two being confined to South America and the third to Sumatra, the Malay Peninsula, and part of China. The tapirs have a massive hog-like body, with a very thick skin, covered with rather scanty short hair. The head is large and conical, with the muzzle produced into a short flexible proboscis, which has considerable powers of prehension, and is used for conveying food into the mouth; the nostrils are situated at its tip. The neck is thick, the ears short, and the eyes small. The legs are moderately long; the fore feet have four toes, the outermost of which is small, and does not reach the ground; the hind feet have three toes; the tail is very short. There are two mammæ placed on the groin. The skull resembles that of the pig in its pyramidal elevation, but differs in presenting only three faces instead of four. There are forty-two teeth, arranged as follows: —

$$i.\ \frac{3-3}{3-3};\quad \frac{1-1}{1-1};\ pm.\ \frac{4-4}{3-3},\qquad 3-3$$

The outer incisors in the upper jaw are very large, and resemble canines, while those below are very small. The canine teeth are very small. A wide interval divides the canines from the premolars.

Skull of American Tapir.

Of the American tapirs two species are known, one of which, the Common American Tapir (*Tapirus americanus*), is very extensively spread throughout the warmer regions of South America, where it inhabits deep forests, leading a solitary life, and seldom stirring from its retreat during the day, which it passes in a state of tranquil slumber. During the night, its season of activity, it wanders forth in quest of food, which consists of water-melons, gourds, young shoots of brushwood, &c. Its choice of food is not very limited, and, indeed, it appears to be as omnivorous as the hog. Clay, wood, pebble, and bones are frequently found in its stomach. Its senses of smell and hearing are extremely acute, and serve to give it notice of the approach of enemies. Its voice, which it seldom utters, is a shrill kind of whistle, in strange contrast with the massive bulk of the animal. Of enormous muscular power, and defended by a tough thick hide, the tapir is capable of tearing its way through the underwood in whatsoever direction it pleases. When thus driving onwards it carries its head low, and, as it were, ploughs its course. Its fondness for the water is almost as strong as that evinced by the hippopotamus; it swims and dives admirably, and will remain submerged for some minutes, then rise for a moment to the surface in order to take in a fresh supply of air, and plunge again.

The tapir is easily domesticated, and becomes as quiet and familiar as the hog. The female produces usually only one offspring at a birth. The chief natural foe of this beast is the jaguar, but the latter is by no means always the victor. The young are longitudinally marked with spots, and six or eight bands of fawn colour along the body, and with numerous spots of the same tint on the cheeks. The adult is of a uniform deep blackish-brown, with the sides of the lower lip, a band on the under and middle part of the chin, the upper edges of the ears, and a naked line at the bottom of the hoofs, snowy white. On the back of the neck, extending to the shoulder, is a thick rounded crest with a short mane of stiff bristles. Its length is about 6 feet, and height 3½ feet. The tapir is hunted for its hide, and also for its flesh, which, though coarse and insipid, is eaten by the natives. It is generally shot with poisoned arrows, but sometimes caught with the lasso or hunted with dogs.

The other American species, the Hairy or Roulin's Tapir (*Tapirus villosus*), is a native of the Cordilleras of the Andes, where it was discovered by Dr. Roulin. It is covered with long, thick, black hair, and has no mane. In its anatomical characters it approaches more nearly to the following species.

The Malay or Indian Tapir (*Tapirus indicus*) was first introduced to science by Major Farquhar in 1816. It is a native of Sumatra, the Malay Peninsula, and the south-west provinces of China. Its habits and manners agree with those of the common American tapir. Its colour is singular. The head, neck, fore-limbs, and fore-quarters are quite black; the body then becomes white or grayish-white, and so continues half way over the hind-quarters, when the black again commences abruptly, and is spread over the legs. The ears are bordered with white. The young, until the age of four months, are black, beautifully marked with spots and stripes of fawn colour above and white below. It is between 7 and 8 feet in length. The proboscis is more powerful and extensible than in the American tapir, being 7 or 8 inches long. There is no mane. The profile of the head is nearly straight, owing to the convexity of the forehead.

Fossil Tapirs.—Remains are found in the Miocene and Pliocene deposits of Europe, and in later Tertiary deposits in the United States. Nearly allied forms belong to the Eocene period, both in Europe and America.

TAPPING, or *Paracentesis*, in surgery, is the operation usually employed for the removal of fluid from any of the serous cavities of the body in which it has collected in a dangerous quantity. It is accomplished by means of an instrument called a trocar, and a tube, or canula, in which it exactly fits. The trocar is of steel, cylindrical through the chief part of its length, and terminated by a three-sided pyramid, which ends in a very sharp point. The canula being placed upon its shaft, the trocar is thrust into the cavity containing the fluid, and being then withdrawn through the canula, the latter is retained in the aperture till all the fluid is discharged. The diseases for which tapping is chiefly performed are ascites, hydrothorax, hydrocele, and occasionally effusions of fluid in the pericardium.

TAR, a thick, black, viscid, impure turpentine, procured by burning the wood of *Pinus palustris*, *Pinus sylvestris*, and other species of pine and coniferous trees, and also by the destructive distillation of shales, bituminous coals, and peat. Wood tar was known to the ancient Greeks, and it is said that the method they adopted for obtaining it is the same as that which is used in many parts of Europe at the present day. It is extensively manufactured from the roots and branches of pines and firs in Norway, Sweden, Germany, Russia, North America, and other places in which these trees abound, that made in the north of Europe being considered the best. In Sweden, where it forms an important article of commerce, some peculiar methods of checking the growth of the trees used are practised in order to increase the yield of tar. In the ordinary process of manufacture a conical cavity, about 9 feet deep and 10 feet of surface diameter, is made in the side of a bank or sloping hill, and the roots of the fir, together with logs and billets of the same, are neatly arranged in the cavity until it is filled. The whole is then covered with turf, which is well beaten down, air being only admitted to the pit by channels passing down to its lower end. The stack of billets is then kindled, and a slow combustion of the fir takes place without flame, as in making charcoal, during which the tar exudes, and is collected in an iron pan at the bottom, from which it is allowed to drain off through a spout into barrels. These when filled are closed up, and the material is ready for exportation.

The variety known as coal tar is obtained when bituminous matters are distilled for the production of illuminating gas. See GAS LIGHTING.

Both wood and coal tars are complex mixtures of a variety of liquids holding solid matters in solution or suspension; thus wood tar contains the hydrocarbons included in the term eupion, and the benzole series of hydrocarbons, including toluole, xylole, cymole, also naphthaline, &c., besides oxidized compounds, including creosote, picamar, kapnomor, &c., rosin and paraffin being among its solid contents. When its volatile products have been driven off by distillation or boiling, the black carbonaceous residue is known as pitch. The composition of coal-tar is materially different, as it contains all the great variety of products derived from the destructive distillation of bituminous coal as obtained from the gas works. Coal-tar has an exceedingly repulsive odour, and it was long regarded as a troublesome and valueless by-product of the gas manufacture, chiefly useful for mixing with the fuel by which the retorts were heated. Now, owing to the progress made in practical chemistry, the coal-tar has become a substance of so much value that it ranks second only to the gas itself, and it has even been asserted that it will be necessary to go on making gas whatever new methods of lighting and heating may be discovered, for we cannot get on without coal tar. In its crude state it is chiefly useful as a coating for iron work exposed to the weather, for admixture with asphalt and other substances for paving and roofing purposes, and for mixing with coal dust to make fuel; but when it is distilled it yields from 3 to 15 per cent. of light oils, from 60 to 70 per cent. of heavy oils, and from 18 to 35 per cent. of pitch. The light oils are made by various processes to yield the rich colours applicable to dyeing, known as the ANILINE colours, and also flavours of various essences, and some agreeable perfumes. The heavy oils are burned for the production of lampblack, and they also yield carbolic acid (phenol), cresylic acid, and anthracene. The pitch left after the heavy oils have been distilled over is a hard, black, shiny substance, which breaks with a glassy fracture. Wood tar is used on account of its antiseptic properties as a preservative coating for exposed wood work, ships' sails, ropes, tarpaulins, &c., and it is boiled down to produce the pitch used to cover the bottoms of ships.

Medicinal Uses of Tar.—Wood tar is the only kind used in medicine. Tar water, made by stirring up tar with cold water, and after giving the tar time to subside, drawing off the liquid, was about a century ago regarded as a valuable remedy for a great variety of diseases. Bishop Berkeley published a work entitled "Siris," in which he extolled its virtues very highly, and based his encomiums upon his personal experience, but his estimate proved afterwards to be exaggerated, and tar suffered undeserved neglect at the hands of the medical profession. At the present day it is largely used on the Continent in the treatment of winter cough, chronic bronchitis, and asthma, and there can be no doubt that it is a remedy of considerable value. It is prepared in the form already mentioned of tar water, in the shape of pills, and is also inclosed in capsules. Externally tar is used as an application to some kinds of ulcers, and it is of great value for the treatment of several forms of skin disease. Creosote, obtained from the distillation of wood tar, is used to relieve toothache, as a remedy for checking vomiting, and in the treatment of chronic bronchitis or winter cough.

TA'RA, the name given by the South Sea Islanders to the edible roots of several plants, but chiefly to the rootstocks of *Colocasia macrorhiza*, a species belonging to the order AROIDACEÆ. The rootstock is very large, and has a very acrid taste, which is removed by cooking. It is also ground into flour. In the Sandwich Islands the name is also given to the rootstock of *Caladium esculentum*, another aroid, which is used in the same way, and is commonly sold in the native bazaars in India. The name is also given by the natives of Australia to the rootstock of the edible Brake (*Pteris esculenta*), a species of fern, which is used in the same way as the Colocasia. In India the name is employed for a species of palm belonging to the genus CORYPHA.

TA'RAI or **TOOREE**, a sort of brass trumpet of the Hindus, especially used to blow upon at the cremation of the dead, or when offering oblations to the souls of the departed.

TARAN'NON SHALES, in geology, a series of shaly and slaty deposits forming the lower part of the WENLOCK BEDS (Upper Silurian) in Central and North Wales. They are so named from their great development near Tarannon, in Montgomeryshire, where they are said to attain a thickness of 1000 feet. Fossils are rarely discovered, and the few to be met with are much like those of the strata immediately above.

TARANTEL'LA, a rapid whirling dance-measure in 6–8 time, the pace continually increasing as the piece proceeds, and the sections alternating from major to minor.

The form derives its name from the curious remedy of dancing for a sort of madness called *tarantism*, which much afflicted Italy from the fifteenth to the seventeenth century, and which was said to arise from the bite of the tarantula spider. This spider has, however, since been proved to be quite innocuous. It is more probable that the name of the disease arose from the city of Taranto (Tarentum), where the disease first broke out. The sufferers made continual contortions, and had an insane desire to plunge into water—many deaths occurring thereby. The cure was by music, and the patient had to dance until he fell from exhaustion; and probably its work was due to the increased flow of blood and the probably copious perspiration such a violent trial would produce. Some of the curative melodies are preserved. They are written in the old modes, and are not improbably snatches of old Greek tunes preserved at Tarentum. These melodies are not dance tunes, and probably were believed to have some magical effect. Dance tunes were woven in with them. The modern use of the word applies to the dance tune only. See the capital description in "Corinne" (Madame de Staël); and also "Vergaris Tarantismo" (Naples, 1839).

See also CHOREA, and for a full description of this disease Hecker's "Epidemics of the Middle Ages."

TAR'ANTISM. See TARANTELLA.

TARAN'TO, a town of Southern Italy, in the province of Lecce, at the northern extremity of the Gulf of Taranto, is the seat of an archbishop, and had 33,942 inhabitants in 1881. It occupies a small part of the site of ancient TARENTUM, of which there are few remains. The town, which stands at the head of the Gulf of Taranto, on an island joined to the mainland by two stone bridges, is pretty well built, although the streets are rather dark and narrow; it is fortified, and has a castle, a cathedral, episcopal palace, several churches, and convents. The cathedral is dedicated to St. Cataldo, a native of Raphoe, in Ireland, who was the first bishop of Taranto. The inhabitants carry on some trade by sea in small craft. Linen, cotton, muslin, and velvet are manufactured here. Excellent oysters and mussels are found on the coast, and a large part of the population is employed in fishing. The inner port is nearly filled up, but the outer or large one is accessible to vessels of good size, and is protected by two islands situated at its mouth. Much wool is produced in the neighbourhood of Taranto. Two lagoons, which lie south-east of the town, communicate with the sea, and yield a great quantity of salt by evaporation.

TARAN'TULA (*Lycosa tarantula*) is a species of SPIDER belonging to the family Lycosidæ or Wolf-spiders, and derives its name from Taranto in Italy, in the neighbourhood of which it is especially common. This and nearly allied species are common throughout Southern Europe. They are large spiders, over an inch in length, with an elongated body and rather long legs. The bite was formerly supposed to produce a peculiar disease called *tarantism*, which seems to have been a sort of dancing madness which could be cured only by music. It has been proved, however, that the bite of these spiders, though severe, is in no way venomous.

TARASCON, a town of France, in the department of Bouches-du-Rhone, 11 miles S.W. of Avignon, on the left bank of the Rhone, opposite Beaucaire, with which it communicates by a handsome suspension-bridge. The chief public buildings are the ancient castle, now used as a prison, several churches, the *hôtel de ville*, and a palace of justice. There are a communal college and hospital. The manufactures are raw silk, woollen stuffs, handkerchiefs, soap, and chemicals; and there is an extensive trade in corn, wine, oil, madder, and other products of the surrounding country. The population in 1886 was 9314. A strange procession of mummers, accompanying a canvas dragon and headed by the clergy, took place annually until recent times, in commemoration of a legend of the delivery of the town from a dragon by Martha, who had landed in Languedoc with her sister Mary Magdalene.

TARAU. See THRO.

TARAX'ACUM. See DANDELION.

TAR'BERT, LOCH, two inlets of the sea, on the west coast of Scotland: East Loch Tarbert, running off Loch Fyne, forming a safe harbour; and West Loch Tarbert, a narrow arm of the Atlantic, 10 miles long. These approach within one mile of each other, forming an isthmus, which unites the peninsula of Cantyre to the mainland of Argyleshire. There is a tradition that this isthmus was, within the historical period, covered by the sea at high-water, thus rendering Cantyre an island.

TARBES, an ancient town of France, the capital of the department of Hautes-Pyrénées, is situated on a fertile plain, on the left bank of the Adour, 22 miles E.S.E. of Pau. It is well built, with fine spacious streets, and has beautiful avenues and promenades, a cathedral, built on the ruins of the ancient fortress of Bigorre; episcopal palace, now used as a prefecture, communal college, library, and theatre; an hospital, agricultural society, &c.; tanneries, foundries, paper-mills, and large markets. The Spanish cattle-dealers come to this market to buy cattle wholesale. The population in 1886 was 25,146. Tarbes is said to occupy the site of the castle of the Counts of Bigorre, of which Tarbes (the city of the Tarbelli) was the capital. The English monarchs retained possession of Bigorre, which, with Guienne, formed the dowry of Queen Eleanor, for 300 years, down to the reign of Charles VII. Marshal de Castelnau, General Dembarrère, and the infamous Barrère, of the Convention, were natives of Tarbes.

TAR'DIGRADA. See WATER BEARS.

TARE (Fr. *tare*, waste; from Lat. *tero*, to rub away). The words *tare*, *tret*, *cloff*, *suttle*, *gross*, *net*, still hold their places in works of arithmetic, and are occasionally used in commercial transactions. Tare is distinguished into *real* tare, *customary* tare, and *average* tare. The first is the absolute weight of the packing, or box, barrel, &c., which holds the merchandise, and which must of course be deducted in ascertaining the real weight of the merchandise; the second its supposed or customary weight; and the third is the medium tare deduced from weighing a few boxes, &c., and taking them as the standard for the whole. The prevailing practice in this country is to ascertain the real tare. *Tret* is an allowance of 4 lbs. in 104 lbs. for waste; *cloff*, an allowance of 2 lbs. in 3 cwt., that the weight may hold good when sold by retail; the *gross* weight, that of the goods and boxes all together; the *suttle* weight, that which remains when tare only is allowed; the *net* weight, that which remains when all allowances are made.

TARE (Ervum) is a genus of plants belonging to the order LEGUMINOSÆ, suborder Papilionaceæ, nearly allied to Vicia (VETCH), from which it is distinguished chiefly by the segments of the calyx being narrow, sharp, nearly equal in length, and almost as long as the corolla. Two species are common weeds in cornfields and hedges in Britain, the Hairy Tare (*Ervum hirsutum*) and the Smooth Tare (*Ervum tetraspermum*). They have small, pale blue flowers. The former species, which is the most common, is frequently a great pest, as it climbs about the wheat and bears it to the ground. This species has a hairy two-seeded pod, and is so distinguished from the smooth tare, which has a smooth pod containing four seeds. The herbage of both is nutritious, but the quantity is so small as to be worthless for cultivation as food for cattle. Another species largely cultivated for the nourishing food afforded by its seeds is the LENTIL (*Ervum lens*). The name is often given to the Common Vetch (*Vicia sativa*).

The plant referred to in our Lord's parable of the wheat and the tares is probably the DARNEL (*Lolium temulentum*), a species of grass.

TAREN'TUM, or in ancient Greek *Taras*, one of the Greek cities of Italy. The southern part of the Italian peninsula was so crowded with cities founded by Greek colonists that it received the name of *Magna Græcia*: and of these cities the greatest was Tarentum. In fact it gives its name to the mighty gulf which cuts the "boot" of Italy into a toe and a heel. It was named after Taras, a son of Poseidôn, and was founded by the Iapygians and Cretans combined. These were driven out, however (B.C. 708), by a company of illegitimate Spartan youths born during a long absence of their fathers in the wars of Messênê, and smarting too much under the disgrace of their birth to remain in their native city. Under its new masters Tarentum sprang quickly to the headship of the Italian Greek cities. In its finest time it had about 22,000 inhabitants, but could raise an army of 30,000 with the assistance of its allies and subject towns. Tarentum was a vigorous maritime state.

Tarentum offended Rome by her high-handed conduct upon the sea, and having become so luxurious in habits of living as to be unable to cope with Rome in the quarrel

which suddenly sprang up, the Tarentines invited Purrhos, king of Epeiros, to come to their assistance (B.C. 281). The Epeirot king, however, had ultimately to withdraw from Italy, and Tarentum then quickly fell a prey to Rome (B.C. 272). Having revolted in the Second Punic War, and given great assistance to Hannibal, Tarentum was treated with ruthless severity when the fortunes of war again brought her to the feet of her great mistress (B.C. 207). She was made a Roman colony, and with the loss of her independence lost what remained of her spirit. Wealth and population steadily declined, although the town long remained a place of importance. "Soft Tarentum" (*molle Tarentum*) Horace calls the town, alluding to the love of luxurious living, which was the bane of the Tarentines, but which, so far as we are concerned, is rather typified in the term *Sybarite* than *Tarentine*. (Sybaris was a not far-distant city.) Greek was spoken at Tarentum all through the times of the Roman Empire, and greatly in consequence of this it was in the dark ages of invaluable aid to the Eastern or Byzantine Empire in retaining its slender hold upon Italy. The wool, fruits, and dye-stuffs of Tarentum were famous throughout antiquity. The modern town is called TARANTO.

TAR'GUMS, a Chaldee word of uncertain origin, used to designate certain Aramaic paraphrases and versions of the books of the Old Testament. During the period of the Babylonish captivity, the language of the Jews was affected by the dialect spoken at Babylon to such an extent, that upon their return they could not understand the pure Hebrew of their sacred books; and, therefore, when the law was publicly read to the people by Ezra and his assistants, they found themselves obliged to add an explanation of it, undoubtedly in Chaldee (Nehem. viii. 8). In the course of time there arose a guild of interpreters, who translated the sacred books and offered explanation at all public services, who were termed the *Meturgemanim*, and who appear, unlike the Rabbis, to have been paid for their services. It was forbidden for a long period to commit either translation or explanation to writing, but the rule was violated by degrees, until by the end of the second century A.D. the practice of writing translations or Targums had become fixed. The work of collecting and comparing the versions of individual translations and reducing them to one was probably accomplished by the schools of Babylon about the end of the third or the beginning of the fourth century. None of the extant Targums covers the whole of the Old Testament, but taken together they cover the whole of the books with the exception of Ezra and Nehemiah. The most ancient and in many respects the best of the Targums is on the Pentateuch, and is usually called the "Targum of Onkelos" the Proselyte. Onkelos, according to tradition, was a pupil and friend of Gamaliel, who died not long before the destruction of the temple; but, as we have said, the work itself was most probably prepared at Babylon more than two centuries later. The "Targum of Onkelos" is written in Chaldee, closely approaching in purity of idiom that of the Book of Daniel, and it is as faithful to the original as its design of a version for the people would permit. Its explanations of difficult passages are very clever and terse, additions of any length being confined to the poetical portions, and the version is remarkable for the care taken to avoid all anthropomorphic expressions. With respect to the text from which it was prepared, it can only be said that it appears in the main to have been one not greatly differing from the Masoretic text of the present day.

The Targum second in time and importance is that called the "Targum of Jonathan ben Uzziel," or "Targum on the Prophets," embracing Joshua, Judges, Samuel, Kings, Isaiah, Jeremiah, Ezekiel, and the twelve minor prophets. The reputed author was a pupil of Hillel, but the Targum, which is evidently later than that of Onkelos, must be ascribed to the schools of Babylon, and dated not earlier than the fourth century. The third and fourth Targums are essentially one work, and though known respectively as the "Targum of Pseudo-Jonathan" and the "Targum of Jerusalem," it seems that down to the fourteenth century they were included together under the last-named title. The "Targum of Pseudo-Jonathan" is written in a Jewish-Aramaic dialect approaching Syriac, and was probably written in Palestine during the second half of the seventh century. It covers the whole of the Pentateuch, but the "Targum of Jerusalem" seems to be a collection of amplifications, emendations, &c., to the "Targum of Onkelos." They are both very rich in HALACHAS and HAGGADAS on the text. The fifth class of Targums are those on the Hagiographa, assigned by tradition to Joseph the Blind, a famous Rabbi of the fourth century, but which probably originated in Syria some time between the ninth and the twelfth centuries. They embrace Proverbs, upon which the Targum is both faithful and complete, Job and Psalms, mere collections of fragments, and on Canticles, Ruth, Lamentations, Esther, and Ecclesiastes, upon which they are rather continuous Haggadic commentaries than versions. Their language is about equally related to Eastern and Western Aramaic. The sixth Targum is on Chronicles, and it was unknown to scholars up to the close of the seventeenth century. It appears to have been made in Palestine at a very late period. The seventh "Targum," according to the enumeration of Deutsch, is on Daniel, has only been known within the last forty years, and exists, so far as known, only in a translation of a portion of it into Persian. It contains manifest allusions to the Crusades, and may possibly have been written during the Christian rule at Jerusalem in the twelfth century. The eighth Targum is on the apocryphal portions of Esther, and has no particular value. Many fragments of lost Targums are scattered in various works of Semitic literature.

Up to the present no good critical edition of the Targums has been prepared, but most of them are included in the large polyglot editions of the Bible, and a much improved edition of the "Targum of Onkelos" was published at Wilna in 1852. For an extended discussion of the Targums, condensing all the chief points of interest of the subject, see the "Literary Remains" of Emmanuel Deutsch.

TARI'FA, a fortified seaport of Spain, situated in the narrowest part of the Strait of Gibraltar, 15 miles W.S.W. of the city of Gibraltar, on a point of land projecting into the sea. It has about 10,000 inhabitants. It is the most southern town in Europe, and is thoroughly Moorish in appearance; and takes its name from the Moorish leader Tarif Ibn Malek, who landed on the little island facing the port (now joined by a causeway to the mainland) with a small force in the year 711, for the purpose of reconnoitring, previous to the conquest of the country. In 1295 it was besieged by the Moors under Abú Yusuf, but was stoutly defended by Don Alonso Perez de Guzman, who would not surrender it, notwithstanding that they threatened to behead his only son, and actually carried out their threat before his eyes. In 1340 a great battle was fought near Tarifa, between Alfonso XI. of Castile and Abú-l-Hasan, sultan of Fez and Morocco, when the former was victorious. The French attacked the town without success in 1811 and 1812—although they had a force of 10,000 men, while the garrison (chiefly British) only numbered 2500; but they took possession of it in 1823. The inhabitants are engaged chiefly in tunny and anchovy fishing and the coasting trade. The harbour is protected with a lighthouse and a modern fort on a rocky island.

TAR'IFF, a list of dues, is a word of curious origin. It is simply *El Tarifa*, the rock at Gibraltar, named after an

early Moorish conqueror. As the Spaniards levied dues upon all vessels passing the Straits of Gibraltar in their days of pride, the list of these was called the "Tariff dues," and hence the origin of our word.

The principle of a tariff depends upon the commercial policy of the state by which it is framed, and the details fluctuate with the change of interests or the wants of the community, the exigencies of the government, or in pursuance of commercial treaties with other countries. In 1842 the Customs Tariff of Great Britain numbered no fewer than 1052 articles, *export* duties being levied on five principal articles with nineteen subdivisions, besides an *ad valorem* duty of one-half per cent. chargeable, with few exceptions, on all other goods shipped for exportation. Now export duties are wholly abolished, and the Customs Tariff contains less than a score of articles, of which the chief are, cocoa, coffee, chicory, dried fruits, tea, tobacco, spirits, goods containing spirits, wine, beer, playing cards, and gold and silver plate. In the United States the term is exclusively applied to the law which fixes the import duties.

The *Tariff Value* of the coinage of any country (that is, its value as bullion) is less than its Mint par value by certain allowances, the chief of which are—(1) for wear and tear; (2) for seignorage, that is, the cost of coining or Mint charge; and (3) remedy, which is the margin of error in the composition of the metal. In England this last is ·02 of the Mint par value. Where no charge for coining is made (as in England, for gold coins) the tariff value is not very different from the par value; but the difference in other countries is sometimes great. In France the seignorage of 6 fr. 70 c. per kilogramme, and the other allowance of 2 fr. 41 c. make up a difference of 9 fr. 11 c. per kilogramme charged against the person who takes even such fine gold as English sovereigns to the French Mint to exchange for French money. This 9 fr. 11 c. must be deducted from the Mint par value to get the tariff value in the case considered.

TAR'LATAN, a thin gauze-like fabric of cotton, of which ladies' ball-dresses are often made. It is usually dyed or printed in colours. The chief seat of the manufacture of tarlatan is at Tarare in France.

TARL'TON, or **TARLETON, RICHARD,** was born in Shropshire. He was distinguished for his performance of the clowns of the old English drama, in which he is spoken of as having been unrivalled, and seems besides to have been one of those clowns who spoke "more than was set down for them." One of his last performances was in "The Famous Victories of Henry V.;" this was in 1588, at the Bull in Bishopsgate Street. He is known to have written at least one play, "The Seven Deadly Sins," which, though never printed, and now lost, was much admired. He died in 1588.

TARN, a department in France formed out of portions of Upper Languedoc, and named from the river Tarn, which crosses it from east to west, is bounded N.W., N., and N.E. by Tarn-et-Garonne and Aveyron, E. by Aveyron and Hérault, S. by Aude, and W. by Haute-Garonne. Its greatest length is 66 miles; the average width is about 44. The surface measures 2216 square miles, and the population in 1886 was 358,757.

Physical Geography.—The department lies entirely in the basin of the Garonne. A chain of mountains traverses the northern part of it in a direction parallel to the course of the Tarn, along the southern bank of which is a similar but lower range. On the southern border runs the crest of the Montagne Noire, a branch of the Cévennes, from which range another projection (the Sidobre), running east and west, separates the waters of the Adou from those of the Agout in the upper part of their course. The Rock of Montalet, the principal peak, is 4430 feet high. The highlands of the department generally terminate in flat summits, and their declivities, as well as their numerous isolated hills that stud the surface, are cultivated. The only exception to this are the arid rocky range that approaches the Aveyron on the northern boundary, and the higher parts of the Sidobre chain. The other general features of the department are numerous deep narrow valleys, drained by rapid streams which form waterfalls, and in the centre and west fertile plains of considerable extent.

The chief river is the Tarn, which rises in the department of Lozère, on the southern slope of Mont Lozère. Crossing the south of this department first in a westerly, then in a south-western direction, it traverses Aveyron and Tarn in a course west by south, passing Milhau, Alby, Gaillac, and L'Isle, below which it enters Haute-Garonne, but almost immediately wheeling to the north-west leaves this department and enters Tarn-et-Garonne, where, having passed Montau and Moissac, it throws itself into the Garonne on the right bank, after a course of 215 miles, only 78 of which, from Alby to its mouth, are navigable. The Tarn flows in a very deep bed, bordered by high banks. It is subject to floods at the season when the snows melt on the mountains. Its principal feeder in this department is the Agout, which, swelled by the Sor and Adou, drains all the southern portion, and enters the Tarn on the western boundary. The Aveyron and its feeder the Viaur, form a considerable portion of the northern frontier. The other affluents of the Tarn—the Dourbie, the Sorgues, the Rance, on the left; and the Aveyron on the right—are noticed under AVEYRON. About 4 miles east of Alby is the Saut-du-Sabot, a series of rapids by which the river makes a descent of 60 feet.

Soil and Products.—The soil of the plains, valleys, and lower slopes is good, yielding in the south and west abundant crops of wheat, maize, rye, hemp, flax, some woad, aniseed, fruits, pulse of all kinds, and potatoes. The most approved methods of agriculture are in use. On the highlands the products are hemp, rye, oats, buckwheat, chestnuts, walnuts, and timber. The breadstuffs raised exceed the home consumption. The vineyards yield good wine. The wines of Gaillac, both red and white, are the best made in the department. The pastures on the hill sides and in the valleys are good, so that many sheep, horned cattle, and pigs are reared. A good breed of light horses prevails; the calves and poultry of the district are in good repute; bees are very carefully tended; and silkworms are reared. The forests, which cover one-fifth part of the surface, consist of oak, beech, ash, and maple. The cultivated trees are principally chestnut, walnut, cherry, and some mulberry and olive trees.

The climate, except in the narrow valleys, where fogs sometimes prevail, is genial and healthy. Winter lasts from mid-December to mid-February, and at the maximum cold Fahrenheit's thermometer marks 18·5°. Spring lasts but a short time; April and May are not unfrequently warmer than June. The greatest heat in July and August ranges between 88·25° and 104°, the highest temperature experienced during the hottest summer. The autumns are long and delightful. The prevailing winds are west, north-west, and east.

The mineral wealth of the department includes iron, lead, copper, coal, manganese, marble, gypsum, and potter's clay.

The chief manufactures are woollen cloths, flannel, serge, table linen, canvas, woollen hosiery, cotton cloths, silk and cotton yarn, liqueurs, confectionery, &c. There are also numerous brandy distilleries, copper foundries, iron and steel works, glass works, paper mills, tanyards, and dyehouses.

The capital of the department is Alby, and it is divided into the four arrondissements of Alby, Castres, Gaillac, and Lavaur.

TARN-ET-GARONNE, a department in the southwest of France, was originally part of the province of Guienne, and was formed in 1808 out of portions of

Querey, Rouergue, Agenois, and Upper Languedoc, which were previously included in the neighbouring departments. It is bounded N. by Lot, E. by Aveyron and Tarn, S. by Haute Garonne, and W. by Lot-et-Garonne and Gers. Its length from north-east to south-west is about 60 miles, from north-west to south-east 44 miles; but the average width is only about 25 miles. The area is 1436 square miles, and the population in 1886 was 214,046.

Surface.—The surface of the department is undulating, but level on the whole; and it is exceedingly well watered, being furrowed by numerous streams, forming deep, and in many places narrow valleys. The subsiding swells of a projection of the Pyrenees traverse the country between the Garonne and its feeder the Gimone; the highlands, which hitherto separated the Tarn and the Aveyron, sink into the plain of Montauban; and the hills of Querey, which cross the north-east of the department in several low chains, extend to the right bank of the Aveyron, the Tarn, and the Garonne, and give rise to a great number of streams that empty themselves into one or other of these rivers and their tributaries. The average altitude of these heights is 1000 feet, and the most lofty do not rise above 1600 feet.

Hydrography.—The department takes its name from its two principal rivers, the GARONNE and the Tarn, both of which, as well as the AVEYRON, are navigable. The affluents of the Garonne, besides the Tarn, are the Gimone and the Rats on the left bank, and the Barguelonne on the right.

Soil and Products.—The alluvial plains along the rivers, and the lower parts of the valleys, are among the most productive lands in France, yielding a large quantity of the best wheat, besides maize, barley, hemp, tobacco, oleaginous seeds, pulse, potherbs, &c. The soil of the hill slopes and higher plains is generally composed of a whitish earth mixed with clay and fine sand, or in some parts with gravel; it will not produce corn, but is admirably adapted for the culture of the vine. Superior red wines, which keep and bear transport well, are made in the district between the Tarn and the Garonne. The natural pastures and artificial meadows are comparatively of small extent, and insufficient for the nourishment of the cattle kept. This deficiency is supplied during a great part of the year by green food; but in winter the fodder of cattle is wheat straw with some potatoes, beans, and the pulp of oleaginous plants. The hay and the oats are reserved for feeding horses and mules. The department is famous for its large walnuts and chestnuts; other articles of culture are black millet, buckwheat, melons, turnips, flax, and fruit of all kinds. The white mulberry is grown to a small extent. Game is abundant, including wild boars, badgers, hares, ortolans, red and gray partridges, and woodcocks. Of fish, salmon, sturgeon, shad, and lampreys are the most common. Horses and mules of great beauty are reared in large numbers; horned cattle and pigs are numerous; sheep few. Ducks, geese, turkeys, and other poultry are plentiful. Bees and some silkworms are tended.

Climate, &c.—The climate is temperate and healthy but variable. The spring is in general rainy; the summer, at first mild, becomes very hot towards the end of July; autumn, as in all the south of France, is almost invariably fine; winter is dry and cold, but snow is rare.

The agricultural population of the department is not grouped in villages and hamlets, but dispersed over the country, farmers in almost every instance residing upon their own holdings; these are mostly inclosed by quickset hedges, which with the numerous clumps of quince trees, the chestnut grounds, and other plantations, give the country a pretty appearance.

The minerals include only iron, coal, marble, building and lime stone, marl, and potter's clay. The manufactures are confined to the towns; they comprise woollen cloth, canvas, serge, silk stockings, cutlery, soap, and woollen yarn; but none of them are of much importance. The chief exports are corn, cattle, wine, and brandy, which are principally sent to Spain and Italy. Flour ground in the Montauban mills is largely exported. Other articles of trade are plums, oil, saffron, wool, paper, hides, &c. The exports are shipped from Bordeaux.

The department is divided into the three arrondissements of Montauban, Moissac, and Castel-Sarazin. The chief town is MONTAUBAN.

TARNO'POL, a town of Austrian Galicia, is most delightfully situated on the Sered, 80 miles E.S.E. of Lemberg. Population, 16,000. It has a gymnasium, and Roman Catholic and Greek united churches. A very extensive horse fair is periodically held here.

TAR'NOW, a town of Austrian Galicia, on the Biala, is 49 miles east of Cracow, on the Vienna and Lemberg Railway. Population, inclusive of the suburbs, 16,400. It is a bishop's see, has manufactures of linen and leather, and a good general trade.

TARPE'IAN ROCK, a steep cliff on the Roman Capitol, from which criminals condemned to death were precipitated in ancient times. It was so called (say the Roman writers) from a maiden called Tarpeia, who betrayed the Capitol, of which her father was governor, to the Sabines, who were besieging Rome. Tarpeia noticed the gold armlets of the besiegers, and was base enough to betray the city on condition that the Sabines gave her "what they wore on their arms." When they were in marching order, as she admitted them through the gate, that which they had on their arms was a shield as well as their armlet. Disgusted at the perfidy by which they were profiting, they carried out their vow to the letter, and flung their shields upon the unhappy wretch. She was buried where she lay crushed at the foot of the rock.

TARQUIN'II, an ancient town of Etruria, on the southern bank of the river Marta, which empties itself into the sea a few miles below. Its origin is unknown; but it was in remote times a powerful place, as appears from the wars which it carried on with Rome, and from the remains which have been discovered. Probably it formed one of the twelve republics of Etruria. After the expulsion of Tarquinius Superbus from Rome, in B.C. 509, the inhabitants of Tarquinii were the most zealous and enthusiastic in his cause. About B.C. 397 they again made war upon the Romans, but were defeated by A. Postumius and L. Julius. Hostilities were carried on at intervals until B.C. 356, when the Tarquinienses were again defeated, and Tarquinii was glad to make a truce. It finally became a Roman municipium.

Its site is clearly discernible in the ruins still extant on the hill of Tarchino, near the modern town of Corneto. Numerous works of art have been discovered in the tombs and catacombs. The first of these were opened in 1699, and what was found in them was described by the antiquary Filippo Buonarotti. New discoveries have frequently been made there since that time; the most important are the paintings with which the walls of the catacombs are decorated; but besides these, thermæ and temples with inscriptions, mosaics, and vases, and other works of art, have been found there.

TARQUIN'IUS. According to early Roman history the family of the Tarquinii gave two kings and one consul to Rome. Its origin was traced to the town of Tarquinii in Etruria, and thence to Greece. Modern investigations, however, have shown that they did not come from thence, but must originally have belonged to Latium, and that from the earliest times there existed at Rome a gens Tarquinia.

Lucius Tarquinius Priscus. The old story concerning his birth and his arrival in Rome is this:—During the tyranny of Kupselos at Corinth, Demaratos, who belonged to the noble family of the Bacchiads, was obliged by the tyrant to

quit his native city. He sailed to Etruria, and took up his residence at Tarquinii. Here he married a woman of noble rank, who bore him two sons, Lucumo and Aruns. As an aspiring foreigner could not hope to satisfy his ambition in Etruria, Lucumo, after the death of his father and brother, emigrated with his wife Tanaquil and a numerous band of friends to Rome, where he was favourably received by King Ancus Marcius, and lands were assigned to him. He took the name of Lucius Tarquinius, to which subsequently that of Priscus (the elder) was added to distinguish him from other members of his house. His wealth and prudence induced King Ancus to consult him in all affairs of state, and in his will he made him the guardian of his children, who were yet under age. On the death of Ancus, he succeeded in persuading the people to elect him king, 616 B.C.

Tarquinius Priscus defeated the Sabines, from whom he took the town of Collatia with its territory. He also defeated the Latins, with whom he made peace. Several constitutional changes are attributed to him. He built the Circus Maximus, and is said to have established the Ludi Magni or Romani. The great works of Rome, called the cloacæ or sewers, were begun in his reign. He was killed (B.C. 578) by some assassins, instigated by the sons of Ancus Marcius.

Lucius Tarquinius Superbus, the seventh and last king of Rome, was the son of Tarquinius Priscus. Tullia, a daughter of King Servius Tullius, was married to the gentle Aruns, and her sister to his ruthless brother, Lucius Tarquinius. In concert with Lucius, Tullia murdered her husband and sister, and became his wife. Lucius placed himself at the head of a conspiracy, and slew his own father-in-law, the aged Servius Tullius. He then, with the surname of the Haughty or the Tyrant (Superbus), ascended the throne, 534 B.C., without either being elected by the people or confirmed by the Senate.

The first act attributed to him after his accession is the death of all the senators who had supported the reforms of Servius Tullius. He, in fact, undid all that Servius had done; he took on himself the administration of justice, put persons to death or sent them into exile according to his own pleasure, and kept the whole internal and external administration in his own hands, without either consulting the people or the senate.

He never filled up the vacancies which so frequently occurred in the senate through his executions, banishments, or through the natural death of senators. By cunning and fraud, or, according to others, by force of arms, he subdued the towns of Latium, and placed Rome at the head of the league, which was now also joined by the Hernicans and the Volscian towns of Ecetra and Antium. The wealthy town of Suessa Pometia was besieged and taken. The Latin town of Gabii experienced a similar fate. The fall of Gabi seems to present another side of the character of this cruel and cynical prince. The town had resisted all his efforts to tak it: and he resolved to play upon the generous character of its brave citizens. He sent his son Sextus, covered with tl marks of severe punishment, to take refuge in Gabii, as if flying from the tyranny of his father. Sextus quite deceived the citizens with a plausible tale, and gained their confidence by commanding their troops in some successful skirmishes against the Romans. He then sent to know how the city should be delivered. His father sent no reply. "But," asked Sextus of the messenger, "where was he, what was he doing?" It was answered that he was walking in the garden, and was amusing himself by measuring the poppies and striking off the heads of the tallest with his stick. Sextus saw the meaning of the silent message, and one by one the bravest citizens of Gabii fell by his treachery. Then the city, denuded of leaders, fell into confusion, and Tarquinius found it an easy prey. Sextus became prince of the town he thus basely betrayed. But when the Tarquins were expelled from Rome, the children of those whom he had treacherously murdered rose against him, and put him to death.

Tarquinius built the capitol, with the threefold temple of Jupiter, Juno, and Minerva, and adorned it with brazen statues of the gods and of the early kings. Here he also deposited the oracular books which he had purchased from a SIBYL. His coffers being now exhausted by the great works that he had undertaken, he was tempted to make himself master of Ardea, a wealthy town of the Rutuli. As, however, he did not succeed in his first attack, he laid siege to it. During this siege, Lucretia, the wife of L. Tarquinius Collatinus, in his absence on service with the army, was violated by Sextus, the king's eldest son; Lucretia killed herself, and L. Junius Brutus, a nephew of the king, raised the Romans in revolt, seizing the opportunity for avenging the long series of crimes now ending in this brutality. The tyrant and his family were expelled from Rome B.C. 510.

Tarquinius, however, did not give up the hope of recovering what he had lost. He first sent ambassadors to Rome to demand his movable property. During their stay in the city the ambassadors formed a conspiracy, in which young patricians chiefly joined them. The conspirators were discovered and put to death, and the movable property of the royal family was given up to the people. The king, aided by the inhabitants of Cære and Tarquinii and the Veientines, led forces against the Romans, who, however, defeated their enemies near the forest of Arsia. Brutus fell in this battle in single combat with Aruns, the son of Tarquinius, who now found assistance at Clusium, then governed by Lars Porsenna. During the war of this chieftain with Rome (for an account of which see PORSENNA) Tarquinius is entirely lost sight of in the narrative of the historians; but after its conclusion we find him supported by the Latins, and waging a fresh war against Rome under the Latin dictator Octavius Mamilius of Tusculum. The battle near Lake Regillus (496 B.C.), in which the exiled king lost his only surviving son, decided the contest. The aged Tarquinius retired to Cumæ, which was then governed by the tyrant Aristodemus, where he died the year following (495 B.C.)

Lucius Tarquinius Collatinus, son of Egerius, was the husband of the unfortunate Lucretia. After the banishment of Tarquinius Superbus, Lucius was elected consul together with L. Junius Brutus. But the people, beginning to suspect that he might be tempted to follow the example of his kinsman, and endanger the freedom of the young republic, compelled him to abdicate and to submit to the sentence of exile pronounced upon the whole family of the Tarquinii.

In this legend of the Tarquins there are manifest inaccuracies. From the accession of Priscus to the deposition of Superbus is 106 years, and to the assumed date of the death of the latter 121 years, yet Priscus was in full vigour when he became king, and Superbus was not yet old at his fall; in the face of this it is hard to see how Superbus could be the son of Priscus. Moreover, Servius Tullius married the daughter of Priscus, sister of Superbus and his brother, and yet this sister's two daughters married their two uncles. Again Sextus Tarquinius, who was killed at Gabii, is found leading a forlorn hope at Lake Regillus fifteen years afterwards. Evidently the parts played by Brutus and Scævola are later attempts to account for quaint surnames.

Yet on the whole the legend must be received as authentic. The neglect to consult the elders, the despotic conduct, the storage of grain for personal advantage, the pressure of task work and military labours for dynastic objects, instead of national advantage, are clearly facts; for they may be detected in the blind hatred of the Romans for the name of king, so that Cæsar, who was willing enough to legalize his supremacy under such a title, had to coin the new dignity of imperator, princeps, and what not. As with Cromwell

in England, so with the great Cæsar, it would have been better if the people's jealousy had permitted the obnoxious title, with all its well-known limitations, to be revived instead of plunging into unknown dignities.

TARRAGO'NA, a fortified town of Spain, the capital of the province of the same name, is situated on a hill near the sea, about 50 miles south-west of Barcelona, and has about 25,000 inhabitants. It is the seat of an archbishop, and has a magnificent Norman cathedral (1120), archiepiscopal palace, theological seminary, economic society, and school of design; and manufactures of silk, cotton, and linen stuffs, ribbons, soap, oil, brandy, cordage, &c. There is a good harbour and a considerable export trade, especially of nuts and almonds, wine and oil. The mole, begun in 1790, and finished in 1874, is 4242 feet in length. The remains of Roman buildings are still very extensive, such as a rock cut amphitheatre, an aqueduct, triumphal arch, called the Arco de Sura, on the road to Barcelona, and many inscriptions. The Roman name was *Tarraco*.

Pliny says that Tarraco was founded by the Scipios, who planted a colony in it (lib. iii. c. 3); but most probably it had been founded previously, and was only increased by the Scipios. It was the seat of a principal tribunal, and was, in fact, not merely the capital of Hispania Citerior or Tarraconensis, but of Spain under the Romans, and is then said to have contained 1,000,000 inhabitants. Augustus resided in it for a short period, and Hadrian enlarged its port. It was taken by the Goths in 467, and by the Moors in 714, from whom it was retaken by Alfonso of Aragon in 1220. It was several times the place of meeting of the states of Catalonia. In 1705 it was captured by the English, who at first intended to retain it as a military post, but afterwards abandoned it for Gibraltar. In 1811 it was taken and sacked by the French under Suchet. Orosius, the historian, is said to have been a native of Tarraco, though the fact has been disputed.

TAR'SHISH, a place mentioned in the Old Testament, particularly in connection with the commerce of the Hebrews and Phœnicians. In several passages of the Bible "ships of Tarshish" are spoken of, especially in connection with Tyre, and it is generally agreed that that phrase only describes a species of large ship, such as those used in the trade with Tarshish, just as we formerly spoke of Indiamen. It may also mean an ocean ship, from Sanskrit *Tarishna*, ocean.

It has been generally identified with the Phœnician emporium of Tartessus in Spain, a place which would undoubtedly furnish the products said to have been brought from it, but there is a considerable difficulty about its true position. The ancient geographers place it, some at the the mouth of the river Baetis (Guadalquivir), the most ancient name of which river they state to have been also Tartessus; while oth identify it with the city of Calpe or Carteia, near Mount Calpe, the rock of Gibraltar. The best way to explain and reconcile these statements seems to be by taking the latter as the name of the whole country in the neighbourhood of Gibraltar. In confirmation of this view, Strabo states that the country around Calpe was called Tartessis.

TAR'SIUS is a genus of Lemurs (LEMUROIDEA), forming the family Tarsiidæ. The Spectre Tarsier (*Tarsius spectrum*), a native of the Malay Archipelago and the Philippine Islands, is the sole species of this remarkable genus. The body is about 6 inches long, clothed with a soft reddish-brown fur, and furnished with a slender tail about 9 inches long, the extremity of which is tufted. The head is round, and has a pointed muzzle, large ears, and staring eyes. The most remarkable peculiarity in its structure is the conformation of the hinder extremities, which are of great length, and upon which this little animal is described as leaping about in the forest like a frog. The tarsi are much elongated and very slender, but the feet are considerably widened at their extremity, and the toes exhibit a singular relative proportion. The inner toe, the opposable thumb of the hind feet, is large and powerful, but its next neighbour is the shortest of all; the next toe and the outermost one are about equal in length, and that between them is the longest. By this means the foot acquires a singular bunched and deformed appearance, which, however, is probably in some way connected with the habits of the animal. The second and third toes of the hind foot have short, sharp, pointed claws; the other toes on both feet have scale-like triangular nails. The dentition is also peculiar. There are four incisor teeth in the upper jaw, the two inner teeth being much larger than the outer, and only two incisors in the lower jaw. There are two canine teeth, six premolars, and six molars in each jaw, the teeth of the molar series being much crowded together. The orbit differs from that of any other lemur in being closed behind. See Plate LEMUROIDEA, fig. 5, Vol. viii.

The tarsier is a gentle, inoffensive, nocturnal animal, which may be easily tamed, when it exhibits both intelligence and affection to those who have the care of it. It resides in the damp forests, living under the roots of trees, especially the bamboo, and feeding chiefly on lizards, but also on insects, such as cockroaches. The natives of Java are said to have such a superstitious dread of it, that if they chance to see a tarsier upon one of the trees in the vicinity of their rice-fields, they will immediately abandon the spot from a fear that some misfortune will befall them.

TAR'SUS (Gr *tarsos*, the sole of the foot or the palm of the hand), [in zoology and anatomy, the collection of bones which constitute the first part of the foot, and also the small bones between the tibia and the metatarsus. In birds it corresponds to the tarsus and metatarsus conjoined; and is sometimes applied to the third segment of the leg. In insects the term is applied to the aggregate of minute joints which constitute the fifth principal segment of the foot or leg. The corresponding part of the hand is the *carpus*.

TAR'SUS (Gr. *Tarsos*), now **TERSOOS,** a town on the Cydnus, in Asia Minor, formerly the chief city of Cilicia, is situated in the midst of a beautiful and productive plain, and is about 12 miles from the sea, in 37° N. lat., and 34° 50′ E. lon. The traditions about its origin are various. The first historical notice of Tarsus is in Xenophon, who describes it as a great and flourishing city when it was taken and plundered by the younger Cyrus, who afterwards concluded a treaty with Syennesis, king of Cilicia, who had his place there. Tarsus flourished under the Roman emperors, who gave it various successive names. Under them it was noted for its schools of philosophy even more than its commerce, Strabo considering it superior in this respect to Athens and Alexandra. St. Paul was a native of this town, which was granted the privileges of a free colony by the Romans, and hence the apostle styled himself a free-born Roman, and claimed the rights of a citizen.

Very few remains of the ancient city of Tarsus exist: at the north-west end is part of an old gateway, and near it a very large mound, apparently artificial, with a flat top, from which is an extensive view of the adjacent plain: on an eminence to the south-west lie the ruins of a spacious circular edifice, probably the gymnasium. Lucus, who visited it in 1704, only noticed one inscription. On a rock 3 or 4 leagues from Tarsus is a fortress, called the Castle of Giants. Kazalu, the port of Tarsus, is now about 12 miles distant, and is closed up by a sand-bar. The population of Tarsus in winter is still about 30,000. Corn, cotton, wool, copper, gall-nuts, goat's hair, skins, hides, &c., are exported from it, being extensively produced in the vicinity.

TAR'TAN (Fr. *tire-taine*, a woollen cloth, or our linsey-woolsey), a chequered cloth worn in Scotland, hence

the pattern of the chequers woven in such cloth. The wearing of tartans is, of course, a practice of considerable antiquity. Checks, of which the types are but developed variants, are common among the rudest tribes after the most primitive weaving has come into vogue. To cross his warp and woof would be the first instinct of a weaver aiming at decoration, exactly as the most ancient earthenware was enriched with basket-like patterns. The low state of art feeling in the Highlands, even more than the tenacity of the natives' love for old customs, is proved by the fact that the Highlanders never got beyond that very crude idea of decoration which is involved in tartan weaving. The oldest tartans are the simplest. Less ancient tartans embody a third or even a fourth colour, and the introduction of one or more of these additions in the form of lines. For example, the blue, black, and green tartan of Clan Gordon includes narrow lines of yellow, forming squares inclosing other squares, which have been developed from the green warp and blue woof of the textile itself. The Maclaren tartan introduces black, red, and yellow lines inclosing blue and green dice. The green and blue of the Mackays form one of the best and simplest examples; the tribe is one of the oldest. The Macnaughten tartan, another of the oldest races, is practically one of the simplest, and consists of two colours only, blue and green, yet woven so as to produce a rich effect. The Macpherson tartan is one of the most glaring and complex. Of course it is impossible to date the antiquity of a tribe according to the simplicity or otherwise of the tartans its members now wear. Changes have at various times been made in the patterns employed, and we should require authority for a statement which ascribed to any tartan the honour of having been used during many centuries. Nothing is more common than for an enthusiastic clansman to declare that his ancestors, in periods of remote antiquity, wore the patterns he affects at this day for his waistcoat or his snuff box; on the contrary, not only have variations been made in this respect, but new tartans, such as the hunting plaids of the Macphersons and Stewarts, have been introduced in comparatively late years. Apart from the fine pattern assumed by the Clan Mackay, where a harmonizing purple has been added to the blue and green of the Macnaughtens, while yet no gaudy yellow or red lines intrude, the tartan of the Macleods, black and yellow with a red line, is perhaps, æsthetically speaking, the best. In all probability the white, red, and black lines which distinguish certain tartans (all these colours are in use by the Mackenzies, whose tartan is good) are insertions in more ancient and simpler types, and of the nature of those heraldic "differences" which have been adopted to distinguish one branch of a family from another: compare Campbell of Cawdor, Campbell of Loudon, and Campbell of Breadalbane. Probably the most hideous example is that invention of the tailors, the "Jacobite tartan," which is composed of orange, green, black, white, and, of a colours in the world, pink! Several other types, which we need not name, contest the palm of ugliness, but on the whole this is the worst. Reduction in the sizes of the coloured dice and lines which form all tartans often improves them, as in the comparatively pretty pattern worn by the Macalisters. The best authority on the subject is J. Grant, "Tartans of the Clans of Scotland" (Edinburgh, 1886).

TAR'TAR OF THE TEETH, a substance which occasionally gathers upon the teeth, and which, if not removed, produces disagreeable consequences. Its accumulation may be prevented by the use of a tooth-powder containing chalk or charcoal; but in bad cases it will require to be removed by scraping.

TARTAR'IC ACID. There are five modifications of this acid, but the name is usually applied to the only important form, dextrotartaric acid; the others are lævotartaric, paratartaric (or racemic), mesotartaric, and metatartaric acids. All have the formula $C_4H_6O_6$, but they differ in crystalline form and in their action on polarized light. Ordinary tartaric, or dextrotartaric acid, forms anhydrous rhombic crystals, and rotates a ray of polarized light to the right, as its name implies. It is abundant in the vegetable kingdom, occurring in many acid fruits in the free state, or combined with potassium and calcium. Tamarinds, mulberries, pine apples, and the berries of the mountain ash owe their acidity to its presence. It is also found in potatoes, cucumbers, and Jerusalem artichokes. The only source, however, from which it is manufactured is from crude tartar or argol. This is an impure acid tartrate of potassium, which is deposited from the juice of the grape when it is fermented into wine. It is owing to the facility with which the acid of the wine is thus eliminated that the grape is the only fruit from which a dry wine without acidity can be made; most other common fruits contain principally citric and malic acids, which cannot be got rid of, and remain in the wine after fermentation. The crude argol, which is contaminated with colouring matter, if deposited from red wine, is dissolved in water and recrystallized; it is then known as cream of tartar or pure acid tartrate of potassium ($C_4H_5KO_6$). This is boiled with calcium carbonate, which converts it into neutral potassium tartrate ($C_4H_4K_2O_6$) in solution, and tartrate of calcium ($C_4H_4CaO_6$), which is precipitated. The solution is filtered off and again precipitated by calcium chloride, which throws down the rest of the tartaric acid as calcium tartrate. The two calcium precipitates are then boiled with sufficient dilute sulphuric to convert the calcium into sulphate which deposits; this is filtered off and the solution allowed to crystallize. It is obtained in anhydrous colourless prisms, which are very soluble in water and in alcohol. These melt at 175° C. (347° Fahr.), and are converted into metatartaric acid, which is isomeric. Further heating produces tartralic acid ($C_8H_{10}O_{11}$), then tartrelic acid ($C_4H_4O_5$), and lastly tartaric anhydride, which has the same formula, but is insoluble. Oxidation produces tartronic acid ($C_3H_4O_5$). Reducing agents convert tartaric acid into malic acid ($C_4H_6O_5$) and succinic acid ($C_4H_6O_4$). Tartaric acid is tetratomic, forming neutral, acid, and double salts, of which the most important are the salts of potassium, already referred to. The neutral tartrate ($C_4H_4K_2O_6$) is very soluble in water, and crystallizes with difficulty. The acid tartrate, or cream of tartar ($C_6H_5KO_6$), is only slightly soluble in cold water, and still less soluble in alcohol, which accounts for its deposition from wine, as the sugar is replaced by the alcohol produced by fermentation. It is employed as a mordant in dyeing wool, and is much used in medicine as a purgative and diuretic. Potassio-sodic-tartrate is the well-known Rochelle salt, used in Seidlitz powders as a gentle aperient; it is obtained in large rhombic prisms having the formula $C_4H_4KNaO_6 4H_2O$. Tartrate of lead ($C_4H_4PbO_6$) is a white powder, from which, on ignition in a closed tube, metallic pyrophoric lead is obtained. Potassio-antimonous tartrate, or tartar emetic, $C_4H_4K(SbO)O_6\frac{1}{2}H_2O$, forms octahedral crystals, which were known to the alchemists in the fifteenth century as a violent emetic. It is still used in the form of antimonial wine as an emetic and diaphoretic. Boro-potassic tartrate, or soluble cream of tartar, $C_4H_4K(BO)O_6$, is a scaling salt used in medicine as a purgative. Tartaric acid prevents the precipitation of oxide of iron, and advantage is taken of this to prepare ammonio ferric tartrate, $C_4H_4(NH_4)FeO, O_6$, and potassio-ferric tartrate (C_4H_4KFeO, O_6); both are red scaling salts used in medicine as tonics. Tartaric acid forms a great number of ethers. Ethylic tartrate or tartaric ether is a liquid ($C_8H_{14}O_6$), mixing with water and alcohol; with dry ammonia gas it yields tartramide (C H N O)

Tartaric acid has been produced artificially by several methods, but only on a small scale in the laboratory. It may be detected by the sparing solubility of the acid, potassium salt. Tartaric acid is employed as a mordant in calico printing. It is used also in making acidulated drops and other confections, and enters largely into the numerous saline effervescents so much employed in allaying thirst.

TAR'TAROS, in the Greek mythology, a son of Aithêr (air) and Gê (earth).

In the Iliad the name Tartaros denotes a place, shut in by iron gates, as far below Hades as heaven is above earth. It is also used to designate the region where the souls of the wicked are punished for their crimes.

TAR'TARS, or more properly *Tatars*, a branch of the Mongolian or Turanian division of the human race, principally inhabiting Asia. The name is one of indefinite and indiscriminate application, used with varying comprehensiveness by different writers. In its widest sense it may be regarded as embracing the Altaic group of Mongolians, that is, all the various tribes and nations inhabiting the table-lands of Central and Northern Asia who are not of Aryan blood, including the Tartars proper, the Kirghiz, the Kalmucks, the Mantchus (sometimes called the Mantchu Tartars), the Mongols proper, and the Tungusians, who largely share the physical characteristics of the Eskimos. In a more restricted application of the word, the Tartars comprise the Turanian inhabitants of Turkistan and the adjacent regions. These are the nomad Kirghiz, who dwell in Khokan and Kashgar, on the Pamir steppe, and in the adjacent valleys; the Uzbegs, who have advanced furthest toward settled civilization and constitute the governing class in Turkistan; the Kiptchaks, a semi-nomadic people living in Khokan, who travel with their flocks during the grazing season; the Buddhist Kalmucks of Eastern Turkistan, extending into Dzungaria; the Kazaks, in the region of the Sir Daria; and many smaller tribes. The predatory Turkomans inhabiting the country east of the Caspian, from the Oxus to the Persian frontier, are of Tartaric origin, although the pure Tartar features are preserved in but few of the tribes, owing to the large admixture of Aryan blood. The characteristic Tartar physiognomy appears most distinctively at the present day among the Kirghiz, who have high cheek-bones, noses thick but depressed, narrow eyes, and little or no beard. Almost every grade of variance from this type, however, is met with. Marco Polo's Gog and Magog represent the two genera of the Tartar race, namely, the White Tartars, or Turks, and the Black Tartars, or Mongols proper, who formed the bulk of the followers of Genghis Khan. Indeed, the name Magog is evidently meant for that proud appellation of "the bold," the Mongol, which Genghis Khan bestowed upon his tameless hordes. The word Tartar or Tatar is of Chinese origin, and was applied to early invaders of China from the upper Amur region. They were a warlike and savage race; and possessing vast numbers of horses, they often descended upon the peaceable Chinese, and plundered their villages. The Altai Mountains appear to have been the centre of the great Mongolian migratory movement which began in the fourth century and lasted until the tenth, extending over the neighbouring Asiatic countries, and under Attila far into Europe, where its results may still be traced in the Tartar population of Eastern and Southern Russia.

This scourge of Tartar invasions directly and indirectly has done much to change the face of the world. Its chief permanent direct result was the Great Mogul (*i.e.* Mongol), who continued to rule in Upper Hindustan, really or nominally, until our own times; and its still more important indirect result has been the encampment, so to speak, amidst an European population of the Ottoman Turk, who still drags on a doomed existence by favour of the internecine rivalries of the great monarchies who surround him.

It was in 1206 that Temugin Khan, ruler of the Moguls or Mongols, a name which tradition says he himself gave to his people, received his title of *Genghis* or "Most Great." Neither Khan nor subject could read or write. Genghis first became master of the northern half of China, starting from whence he subdued all the wandering hordes of Central Asia right across to the Volga. The Sultan of Charizme, ruling the lands between the Persian Gulf and Hindustan, resisted the great Tartar. A career of unceasing devastation was the consequence. The Khan, with his 700,000 Mongols, destroyed in four years the civilization that six centuries have not sufficed to replace. His awful career was checked by a rebellion in Tartary, and he died whilst overcoming it, in 1227—the lives of certainly not less than 5,000,000 men lying to his account during his twenty-one years of rule. As the race had begun so it continued. The armies of Kublai Khan waged war at the same time in China, in Syria, and on the frontiers of Germany. For the time there existed a Tatar or Mongol Empire, larger than any ever held by Alexander, by Rome, or by the most extended rule of the Mohammedan Caliphs. [See MONGOLS.] This empire was not only the vastest but the cruellest the world has ever seen. Ungh Khan, usually identified with the Prester John of early travellers, opposed Genghis; he was swept aside by the ruthless conqueror, and his skull served as a goblet for a memento at every Tartar feast. Every city that fell was razed; every treaty made was broken; every opponent was massacred. In 1257-58, Hulagu Khan, brother of Kublai, ravaged Persia, trampling a whole crowd of sultans into the dust, extirpating the heretical sect of the Assassins, and overthrowing and putting to death the last of the Abbasid Caliphs of Bagdad, El-Mostassem (20th February, 1258). It may be remarked that in this very year, curiously enough, Othman was born in Bithynia, who was to give his name to the Ottoman Turks, and was to found the race which eventually replaced the caliphs and has dominated Islam for five centuries. Hulagu and his Mongols, ravaging the whole land like a devouring fire, swept across Asia Minor to Syria. Here he was at first irresistible, as usual; but in 1261 he suffered a check at the hands of the Memluk Sultan of Egypt, the famous Beybars, who had set up the shadowy Fatimid caliphate in the person of a descendant of the Abbasids, by name El Mustansir Billah, and who assumed to be the sword of Islam. By Beybars and his successors the tide of Tartar conquest was stayed.

It flowed again under the terrible Timur (Tamerlane), who, like the sons of Genghis, threatened China on the one hand while he overthrew the newly-founded Ottoman Sultanate on the other; and massacres were held by his order at the same time in Delhi and Ispahan. [See TIMUR.] It was Timur who prepared the way for the life-in-death of the Ottoman Empire. His death alone, in 1405, terminated the ghastly series of cruelties and crimes of Timur the Lame.

Timur had taken Delhi in 1398, but the Tartar dominion there did not outlast its founder in any strength. It was his grandson, Baber, who first really made the Tartar conquest of northern India, from the Indus to the Bay of Bengal, and founded the dynasty of the Mongols or Moguls, which is the Persian form of the name. [See MOGUL EMPIRE.] This was the only enduring Tartar monarchy, and lasted in vigour for two and a half centuries—the last of the "great Moguls" perishing by assassination in 1759. The English then set up a Mogul prince at Delhi, and this dynasty lasted just a century. The last king ruled but little more than his own palace, and having taken part in the mutiny of 1857 was deposed, and died at Rangoon, an exile and a prisoner, in 1862.

TARTAR LANGUAGES. These are the third great branch of the Turanian speech, the other two being the Finno-Hungarian and the Samoyed. They are best considered under the heading TURANIAN LANGUAGES.

Shamanism was the original faith of the Mongols. This was succeeded by Buddhism, which was abandoned for Lamaism about the end of the sixteenth century. Sunni (orthodox) Mohammedanism was the religion adopted by Timur, and this is now professed by the Western Tartars generally, both in Asia and Europe.

TARTARY, or more correctly *Tatary.* This name was in former times given by Europeans to that immense tract of Central Asia stretching across the whole breadth of the continent, from the seas of Japan and Okhotsk to the Caspian, and bounded on the N. by Siberia, and on the S. by China, Tibet, Cashmere, Afghanistan, and Persia. It is separated by the elevated plateaus of the Pamir into two great divisions, Chinese or East, and West Tartary, now almost completely in the hands of the Russians. The term is now often used for TURKISTAN.

TARTI'NI, GIUSEPPE, a musician, was born at Pirano in April, 1692. His father, having been a great benefactor to the cathedral church at Parenza, had been ennobled. Giuseppe was intended for the law, but mixing music with his other studies, it soon obtained undivided sway. In 1710 he was sent to the University of Padua, to pursue his studies as a civilian, but before he was twenty, having married without the consent of his parents, they abandoned him, and he was obliged to wander in search of an asylum. The lady was the niece of the cardinal-archbishop, who regarded the marriage as an insult, and pursued Tartini with hostility. After many hardships he found one in a convent at Assisi, where he was received by a monk, who, commiserating his misfortunes, let him remain till something could be done for him. Here Tartini practised the violin to keep off melancholy thoughts, and the fame of his performances during service brought many visitors to the monastery, by one of whom he was discovered. It was not long till he got his differences accommodated, and settled with his wife at Venice. During his residence here he heard Veracini, whose performance awakened an extraordinary degree of emulation in the young musician. Tartini had never heard a great player before, or conceived it possible for the bow to possess such varied powers of expression. He therefore quitted Venice for Ancona to study in strict retirement. By diligent practice he acquired reputation sufficient to obtain (in 1721) the place of first violin and master of the band to the celebrated Church of St. Antony in Padua. By this time his fame was so far extended that he had repeated offers from Paris and London, but through a singular devotion to his patron saint, to whom he consecrated himself and his instrument, he constantly declined entering any other service. With reference to his celebrated composition "Il Trillo del Diavolo" (the Devil's Sonata), the following anecdote is said to have been derived from Tartini himself:—"He dreamed one night that he had made a compact with the devil, who promised to be at his service on all occasions; and during this vision everything succeeded according to his mind: his wishes were anticipated, and his desires always exceeded by the assistance of his new servant. In short, he imagined that he presented the devil his violin in order to discover what kind of a musician he was, when, to Tartini's great astonishment, he heard him play a solo so singularly beautiful, and with such superior taste and precision, that it surpassed all the music which he had ever heard or conceived in his life. So great was Tartini's surprise, and so exquisite his delight, that it deprived him of the power of breathing. He awoke with the violence of his sensations and instantly seized his fiddle, in hopes of expressing what he had just heard, but in vain." He, nevertheless, composed a piece, which is perhaps the best of all his works, and called it the "Devil's Sonata," but it was so inferior to what his dream had presented, that he declared he would have broken his instrument, and abandoned music for ever, if he could have subsisted by any other means. By the year 1728 Tartini had formed many excellent scholars, and established a system of practice for students on the violin that became celebrated all over Europe. He died on the 26th of February, 1770, at Padua, where he had resided nearly fifty years. Besides his great fame as a virtuoso Tartini ranks high among musicians as a composer and writer of works on method, &c., and as an original thinker on acoustical theory. He advanced the art of writing for the violin considerably beyond the point at which Corelli had left it. His improvement of the shape of the bow and of its handling added greatly to the powers of the violin. His studies, &c., are admirable, and his works contain difficulties which even now perplex the performer and tax his skill, while all is so clear that no one can be at fault as to the manner of performance. His greatest work of studies is a set of fifty variations, called "Arte dell' Arco" (School of Bowing). Another very valuable work of his on graces and ornaments, giving the correct interpretation of signs, many of which are now antiquated, is his "Trattato delle Appoggiatur," &c., of which a good French translation exists. He had enormous renown also as a teacher. Finally, he has the merit of discovering COMBINATIONAL TONES, those musical ghosts long called "Tartini's tones" in consequence. He used the third tone as a test of truth in double stopping, for it only appears when the intonation of the played interval is faultless. His explanation is ingenious, but not correct. The science of the day was of course insufficient. There is much, however, that is very valuable in his "Treatise of Music, according to the true basis of Harmony," published at Padua in 1754, and in his second book on "Musical Principles" (1767). Tartini was above all things original, and like all such characters, while he made some glaring errors, perhaps too easily discernible, he compensated for them by real discoveries.

TARTUFE, a character in Molière's celebrated comedy of the same name—a hypocritical priest, who makes religion a cloak for the most nefarious actions. The great dramatist is said to have drawn from the life in this character, his Tartufe being Père la Chaise, the confessor of Louis XIV., whom he once saw devouring truffles (Fr. *truffes*) with extraordinary zest. The severe satire of the piece was so felt by the clergy that they endeavoured to prevent the production of the play, but the king's patronage smoothed away all difficulties, and it was given to the world in 1669. It was crowned with success. An English version, "The Hypocrite," by Colley Cibber, in which Dr. Cantwell is the principal character, is still occasionally played with much acceptance. Molière's creation has now become proverbial as a nickname for a religious impostor.

TASHKEND', the headquarters of Russian administration, and the largest town of Russian Turkistan, in the province of Sir Daria, 300 miles north-east of Bokhara, in a fertile plain, between the rivers Chirchik and Keles, near their confluence with the Sir Daria or Jaxartes, is surrounded by lofty walls, 12 miles round, inclosing gardens and small houses. It has a fortified castle, mosques, large bazaar, and extensive suburbs. The manufactures, of silk and cotton goods, gunpowder, and iron, are important; and an extensive trade is carried on by caravans between Russia and Turkistan, Persia and India. Russia sends hither sugar and cutlery; Persia, turquoises and pearls; Bokhara, cotton, skins, and clothing; India, indigo, pepper, &c. Russia gained possession of Tashkend in 1865. The population is about 100,000.

TASIM'ETER, THE, is a tension or pressure measurer. It is an instrument for accurately measuring, by electricity, the most minute degrees of heat or cold, and

weight. It is an invention of Edison. The property on which the invention depends is, that the electrical resistance of carbon varies to a marked degree under very slight variations of pressure—in other words, if a current of electricity has a circuit, part of which is formed by a piece of carbon, then very slight pressure applied to that piece of carbon will cause the current to pass more readily, appreciably diminishing what is technically called the resistance of the carbon to the passage of the electric current.

The simplest form of the tasimeter may be thus described:—A flat button-shaped piece of carbon is placed between two discs of platinum, and the three, together with a large strip of vulcanite, are held horizontally between two stout uprights projecting from a rigid base. The carbon button is so placed that it will undergo greater or less pressure, according as the strip of vulcanite between the uprights expands or contracts. It is now necessary to make this carbon button part of the circuit along which an electrical current runs; and to do this a wire from one pole of a galvanic battery is brought into connection with one of the platinum discs, while a wire from the other pole is brought into connection with the other platinum disc. So soon as this is done the current passes from one pole along one wire, through the carbon button, then through a galvanometer, and along the other wire to the other pole.

It is manifest now, that, since carbon possesses the property of varying in resistance to the electric current as it is or less compressed, the needle of the galvanometer will respond to any changes in the carbon button. If the button is compressed (as it would be by the *expansion* of the vulcanite strip), its resistance will diminish, and the needle will indicate the passage of a stronger current by moving further from the zero point. If the pressure on the button be diminished (as it would be by the *contraction* of the vulcanite strip), the needle, by moving towards the zero point, will indicate a weaker current, in consequence of increased resistance by the carbon button.

A reference to our description of the GALVANOMETER will enable the reader better to understand the manner in which the results of the tasimeter are indicated; while those who are familiar with the use of the thermo-electric pile (for convenience called the THERMOPILE) will doubtless be struck with the similarity between the purposes of that instrument and those of the tasimeter. Though, however, the purposes may be the same, they are constructed of essentially different materials, and the tasimeter is a heat measurer of far greater delicacy than the thermopile, and aided by the beautiful reflecting instrument of Sir W. Thomson, the tasimeter shows some very striking results.

In one of Edison's instruments, for instance, the expansion caused by the he of the hand held a few inches from the vulcanite strip sufficed to produce a deflection of several degrees in the needle of a galvanometer, so inferior that it was not affected in the slightest degree when a red-hot iron was held near to a thermopile. With a similar galvanometer a gas jet, 5 feet away, caused the needle to move 4 degrees. A match burning at a distance of 6 inches caused a deflection of 11 degrees. Breathing slightly on the vulcanite caused a deflection of 30 degrees. Edison's little finger produced with the tasimeter an effect six times greater than a red-hot iron with the thermopile, the distances being the same in both cases.

To cause the instrument to measure moisture, Edison substituted a slip of gelatin for the vulcanite between the uprights. A damp piece of paper held 3 inches away from the gelatin caused an expansion of the gelatin, which immediately made the needle shift 8 degrees. A breath on the gelatin moved the pointer through 35 degrees. A lighted cigar at the distance of nearly a foot dried the atmosphere sufficiently to cause a deflection of 7 degrees in an opposite direction, because the gelatin contracted in this case. With but slight modification of form the tasimeter is a very delicate weighing machine; and the pressure produced by the weight of a tiny shred of paper produces a sensible deflection of the needle.

TAS'MAN, ABEL JANSSEN, was one of the greatest navigators of the seventeenth century, and was born probably at Hoorn, about 1600. In 1642 he was selected by Anthony Van Diemen, the governor-general of the Dutch East India Company, to explore the southern coast of the Australian continent, and he left Batavia, 15th August of the same year, in command of two vessels, the *Heemskirk* and the *Zeehaan*. On 24th November, he discovered a coast to which he gave the name of Van Diemen, but which is now known as Tasmania. He doubled its southern extremity, supposing he had passed the southern extremity of the Australian continent, and on 13th December he discovered the southern island of New Zealand, which he named Staten Land, supposing it to be part of Australia. In January he discovered the Fiji Islands, and subsequently returned to Batavia, where he arrived on 15th June, 1643. The success of this voyage induced Van Diemen to commit to him the command of a second expedition to explore the coasts of New Guinea and Australia, concerning which we hardly know anything more than the instructions issued for his guidance, dated from Batavia, 29th January, 1644. Some fragments from this second voyage of Tasman, however, appear in the work of a Dutch writer, Witsen, issued in 1705. The date of Tasman's death is unknown.

TASMA'NIA, formerly called *Van Diemen's Land*, is an island and British colony situated in the southern hemisphere, south of Australia. It is separated from Australia by Bass Strait, which washes its northern shore. The average length is 180 miles, and the breadth 150 miles. The area is 26,215 square miles, or 16,778,000 acres.

Coast-line and Islands.—The western coast, beginning on the north, at Cape Grim, and extending to South-west Cape, is about 240 miles long. It is less accessible than the other shores of the island, as in general it runs in a continuous line, being only broken by two large inlets which form Macquarie Harbour and Port Davey. The coast elsewhere is steep, exposed to a strong swell and surf, and without anchorage or shelter. The southern coast, between South-west Cape and Whale Head, is about 50 miles in length, and runs in a serpentine line, forming several bays, of which a few have good anchorage. The south-eastern extends from Whale Head to Frederik Hendrik Bay, about 60 miles in a straight line. It probably contains a greater number of safe anchorages than any other coast of the same extent on the globe; in fact there is hardly a mile which does not offer a good refuge to vessels. This great advantage is owing partly to the size and form of the island of Bruny, which extends along the coast, and partly to two far-projecting promontories, called Ralph's and Tasman's peninsulas. The strait which divides Bruny Island from the mainland is called D'Entrecasteaux Channel, and extends about 45 miles. The eastern coast, from the northern extremity of Forrestier's Peninsula to Cape Portland, on Bass Strait, is more than 150 miles in length. Many parts of it are difficult of access, but there are several good anchorages and inlets, of which Oyster Bay is the largest. Near to this coast is Maria Island, about 12 miles long, and consisting of two large masses of rocks connected by a neck of land. North of Maria Island, and contiguous to Oyster Bay, lies Schouten Island, which is about 6 miles long and 3 wide. The northern coast extends from Cape Portland on the east to Cape Grim on the west, and is about 160 miles in a straight line. Besides the estuary of the Tamar there are numerous smaller harbours and rivers accessible to vessels of from 80 to 300 tons. North of this coast is Bass Strait, at the eastern entrance of which is the group

of the Furneaux Islands, consisting of two large, four of moderate size, and many smaller ones. The largest, Great Island, extends 40 miles from north to south, and is, on an average, 9 miles wide. South of it is Cape Barren Island, which extends east to west about 20 miles, with an average width of about 5 miles. The strait which divides Furneaux Islands from Van Diemen's Land is called Banks Strait, and is about 10 miles wide. At the western entrance to Bass Strait are Hunter, Robbins, and Three Hummock islands.

Surface, Soil, Rivers, and Lakes.—The interior of Tasmania is remarkably rugged and mountainous, varied by deep narrow valleys, somewhat extensive undulating tracts of country, and open plains of limited extent. The main chain of mountains, commencing in the north-east at Cape Portland, where its continuity with the great east chain of Australia is made apparent by peaked islands extending across the strait, pursues a very irregular course, first nearly due south, at no great distance from the east coast, till it reaches Oyster Bay, where it turns W.N.W., and continues in that direction more than half-way through the centre of the island. It then suddenly resumes its original direction, curving gradually round to the south-east, and finally terminating at South Cape. This tortuous range, forming the watershed of the island, has a mean height of about 3750 feet, and attains its culminating point of 5520 feet in the south-west, in Mount Humboldt, 43° 25′ S. lat., 146° 7′ E. lon. The other most remarkable summits occur in two lofty branches which the main chain throws off. One of these, stretching between St. Patrick's Head on the east and Port Dalrymple on the north coast, presents in succession the elevated peaks of Ben Lomond, 5000 feet; Ben Nevis, 3910 feet; and Mount Arthur, 3900 feet in height; the other, breaking off at Mount Humboldt, proceeds east, and terminates a little west of Hobart, in Mount Wellington, 4195 feet high. Most of the west, and much of the south-west of the island is entirely uninhabited, the impenetrable nature of the vegetation and the alpine character of the region offering, as yet, insuperable difficulties to the settler.

The river system radiates from the central portions of the island towards the coast, and issues from lakes and springs at an average altitude of 2000 feet above the sea. Of these streams by far the largest is the Derwent, which, issuing from the beautiful mountain lake of St. Clair, in lat. 42° south, flows south-east, augmented by the Dee, Ouse, Clyde, Jordan, &c., and after forming a broad estuary, pours its waters into two main channels, D'Entrecasteaux on the west, and Storm Bay on the east side of Bruny Island. For the last 18 or 20 miles of its course, the width of the Derwent is from 4½ to 5 miles, and the depth varies from 15 to 20 fathoms. Another river of much shorter length, but from the width and depth of its channel of scarcely less navigable importance, is the Tamar, which, formed by the junction of the North and South Esk rivers at the town of Launceston, flows N.N.W. into Port Dalrymple. It is the principal outlet for the surplus waters of the north side of the island, and is navigable for the distance of 50 miles. The other principal streams are the Huon in the south; the Gordon, which has its mouth in Macquarie Harbour, in the west; and the Arthur in the north-west. The two last flow through districts of the most inhospitable character. Great or Clarence Lake, the largest in the island, situated near its centre, about 90 miles north-west of Hobart, is 15 miles long by 5 broad, but owing to the numerous creeks and windings of its shores, measures nearly 100 miles in circuit. There are numerous smaller lakes, which feed most of the rivers draining the south-east of the island.

Geology and Minerals.—In all the mountain ranges, and generally throughout the island, the prevailing rocks are crystalline, consisting of basalt, granite, gneiss, quartz, &c., either produced directly by volcanic action, or changed and moulded by it; and hence, as might be expected in such circumstances, the scenery is often of the wildest description. Enormous peaks of the most fantastic shapes tower into the clouds, or overhang profound and tortuous abysses, evidently formed by rending whole mountains asunder. In these the most frightful precipices occur; among others one in Ben Lomond, with a perpendicular depth of 3000 feet. Beyond the range of these convulsions, however, regular sedimentary strata, chiefly of sandstone and limestone, are largely developed, and form gentle hills or undulating valleys, equally remarkable for beauty and fertility, and usually watered by copious streams. The older limestones yield fine varieties of marble, and excellent building stone is obtained from the greenstones, basalts, and sandstone.

The soil of the colony is rich in minerals. In 1872 large deposits of tin ore were first discovered at Mount Bischoff, on the northern side of the island, opposite to Victoria. From the outset the mine in its product of tin proved to be what the Burra Burra of South Australia was at first as a copper mine—viz. a deposit so vast as to render superfluous the ordinarily tardy and expensive operations of mining. A mining fever set in, and successively were discovered, not merely many more tin deposits, but also gold, silver, bismuth, antimony, iron, and coal apparently inexhaustible. The principal coal measures of the north-west coast are at the river Don, and on the Mersey at Latrobe and surrounding districts. The mineral here is of a coarse bituminous quality, approaching to the common slate coal of England. Launceston is partly supplied with this coal. In the Fingal district, on the eastern coast, very superior coal exists, although, owing to the difficulties of transit, little has been done to develop it. In the Mount Nicholas range there is a thickness of about 900 feet occupied by the coal measures series, and containing seams of a very rich bituminous coal. At Ben Lomond, Avoca, and at the St. Paul's River, extensive coal measures also exist, but likewise unworked. At the Douglas River, near Bicheno, on the east coast, at Port Seymour, Port Arthur, and other places, and also in the Huon district, coal has been found, and some of the mines are now being worked for domestic supply.

Climate, Natural Productions, Animals, Agriculture, and Commerce.—In Hobart the amount of rain falling annually varies from 15 to 25 inches. January, February, and March, the summer months, are generally dry, but the climate varies very much according to position. The central parts of the island are about 3000 feet above the level of the sea, and this portion may be said to form a plateau covered with lakes, from which nearly all the rivers in the island flow in different directions. In many parts of the country vegetation suffers from summer frosts; the low damp valleys appear to be most subject to this infliction, from which the sides of the hills seem to be exempt in a great measure. The winter is never severe; snow seldom lies anywhere, except on the elevated plateaus and on the mountain ridges, for more than a day, and the climate is singularly healthy. The temperature, taking the average of nearly twenty years, may be stated at 53° Fahr., and the average annual rainfall at 21 inches. The thermometer during very hot winds has been noted at 105° in the shade, but these occasions are so rare as to make them very remarkable. It seldom falls below 25°, and then only in the higher regions of the colony, and during the continuance of the keen north-west winds. In no season of the year is the weather so excessively hot or cold that the ordinary field operations cannot be carried on without danger to health. The ordinary death-rate is only 13 per 1000 annually.

The continuous ranges of sterile hills and mountains are clad for the most part with impenetrable scrub, stately

gum, stringy bark, and peppermint trees, interspersed with an infinite variety of beautiful flowering heaths. The death-like stillness of the gloomy sunless valleys, choked with an impassable undergrowth of vegetation, and studded with myriads of tapering trees, varying from 50 to 150 feet in height, and so straight and close to each other as to resemble a forest of giant poles in a hop garden, is very striking. The timber is of considerable value. The blue gum, so named from having occasional streaks of a pale blue colour mingled with its delicate white polished bark, may be termed the oak of Tasmania. It has acquired a great fame for its durability, and is consequently much prized by shipbuilders at home and abroad. It possesses the singular property of annually shedding the outer layer of its bark, one-eighth of an inch thick. It also produces large quantities of gum, of a clear, brilliant, red colour, and a remarkably powerful astringent. The stringy bark tree is so named from the fibrous nature of its bark, which is often used as a substitute for rope. The peppermint tree is so called from its long, narrow leaf, partaking strongly of the flavour of penny-royal. The Tasmanian forests also supply ornamental trees in great variety, among which the myrtle is remarkable for the beauty of its veins, and the dog-wood, pink-wood, and musk-wood for their rich and varied tints. All the trees and shrubs indigenous to the colony are in full leaf throughout the year, but the colour of the foliage is influenced by the cold winds and rains of the winter months, when it presents a decidedly brown tint.

The indigenous herbivorous animals are mostly of the pouched kind common to AUSTRALIA, the principal being the kangaroo, opossum, bandicoot, and wombat. The largest carnivorous animal is about the size of a wolf, and is called the native tiger. It is now very seldom seen, but occasionally it attacks sheep in the outlying districts. Another destructive animal, called the devil, is in size equal to a short-legged terrier; its skin is nearly equal in thickness to that of a pig, and is covered with coarse black hair; it is of the bear species, and possesses a power of jaw scarcely inferior to that of the bull-dog. It is very repulsive-looking. Both the devil and tiger always flee from the presence of man; indeed, it is remarkable that neither in Tasmania nor Australia does there exist a quadruped of a character dangerous to mankind. Perhaps the most extraordinary animal in Tasmania is that wonder of nature, the *Ornithorhynchus paradoxus* or Platypus. This animal is oviparous, yet, singular to say, suckles its young. In shape it resembles a small otter, of which it is a species, varying, however, in the very material point that it possesses the head and bill of a duck. It is amphibious, and to be found only in fresh-water creeks and rivers. The birds are similar to those found in Australia, but the emu has become extinct. As a general rule the edible fish are inferior in quality to those found in Great Britain; but there are two or three exceptions, especially in the case of the trumpeter, which sometimes weighs 140 lbs. Sharks of a very voracious kind are found near the coast, and whaling is extensively carried on in the neighbouring seas. There are several species of venomous snakes. In addition to horses, cattle, and sheep, deer and English game birds and salmon have been naturalized. The island, in fact, has become celebrated for its superior horses, and large numbers are exported at prices which well repay the care bestowed. The merino sheep is the staple breed, and the cattle comprise some choice herds of shorthorns, Herefords, and Devons, the last-named breed having of late years been in much demand, owing to its special suitability for the climate.

The arable lands lie mostly in the valleys, and are of unusual fertility. In fact, their great natural productiveness has somewhat encouraged a system of slovenly farming, although improvements are now taking place in this respect in many places. All the ordinary cereals cultivated in England succeed well, but wheat, oats, and potatoes are the chief crops. The wheat produced is generally of a very superior quality. The domestic animals of Europe thrive well, and the open pasture lands are admirably adapted for sheep.

Tasmania, in its longest settled and most cultivated districts, has perhaps a more thoroughly English aspect than any of the other possessions of the empire. There the fruit trees, shrubs, plants, and flowers of our temperate clime, to which the heat and aridity of Australia are fatal, or which can only be raised as impoverished specimens, thrive luxuriantly and seem to benefit by the transportation.

The exports are chiefly wool, gold, tin, timber, fruit, hops, grain, hides and skins, and bark; the imports are chiefly English home produce, such as apparel and haberdashery, cottons and woollens, and wrought and unwrought iron. The home manufactures are important; in addition to the ordinary trades connected with food and attire, there is a growing array of farm implement makers, mills, potteries, shipwrights, tin smelting works, and woollen factories.

Population.—The population at the census of 1881 was 115,705—61,162 males and 54,543 females. These figures show an increase on the previous census of 16,377, or 14·32 per cent. Of the total population 79,991 were natives of Tasmania, 28,243 natives of the United Kingdom, 3987 natives of other Australasian colonies, 844 Chinese, 782 German. The estimated population in 1887 was 140,000. When the island was first colonized by the English, it is supposed to have contained from 5000 to 7000 natives, of the same race, language, and habits as those described in the article AUSTRALIA. The entire race has, however, died out. The causes were partly disease, partly drink, partly the loss of their means of subsistence, but chiefly violence. Early in the history of the colony they unfortunately excited a profound hatred among the settlers, and were hunted down without mercy. In 1830 an attempt was made by the government to capture them, with the view to their protection and preservation, but it was not successful. At length the survivors surrendered in despair, and were humanely treated, fed, clothed, provided with medical aid, and established in Flinder's Island, as a suitable place of residence. In 1835, the epoch of their deportation, they numbered 210 persons; in 1842 these were reduced to fifty-four; and in 1848 to forty-five. The unfortunates were then removed to Oyster Creek, on the south-west coast, prepared for them by the colonial authorities.

Divisions, &c.—Tasmania is divided into eighteen counties, and also, for representative purposes, into electoral districts which do not coincide with the counties. The principal towns are Hobart, the capital, an episcopal city of close upon 30,000 inhabitants, picturesquely situated on the river Derwent, at the foot of Mount Wellington; Launceston, in the north, on the river Tamar, the second town in the colony, with an estimated population of about 18,000; Georgetown, a watering-place at the mouth of the Tamar; Longford, New Norfolk, and Mount Bischoff. Lefroy and Beaconsfield are important mining centres.

Constitution and Government.—The constitution of Tasmania provides for Legislative Council and House of Assembly. The former is composed of sixteen members, elected by all natural born or naturalized subjects of the crown who possess either a freehold worth £20 a year, or a leasehold of £80, or are barristers or solicitors on roll of Supreme Court, medical practitioners duly qualified, and all subjects holding a commission or possessing a degree. Each member is elected for six years. The House of Assembly consists of thirty-two members, elected by all whose names appear on valuation rolls as owners or occupiers of property, or who are in receipt of income of £30

per year for six months prior to 1st November in any year, and who have continuously resided in Tasmania for over twelve months. The Assembly is elected for five years. The legislative authority rests in both Houses; while the executive is vested in a governor appointed by the crown. The governor is, by virtue of his office, commander-in-chief of the troops in the colony; he has a salary of £4000 per annum, besides an allowance of £1000 to defray the expenses of his establishment. He is aided in the exercise of the executive by a cabinet of responsible ministers, consisting of four members, the colonial secretary, the colonial treasurer, the attorney-general, and a minister without office. The members of the cabinet must have a seat in one of the two Houses of Parliament.

Revenue and Expenditure.—The public revenue is chiefly derived from customs duties and the sale and rent of state lands. The revenue and expenditure are each nearly £600,000 per annum. The public debt of Tasmania in 1887 amounted to nearly £3,500,000.

Religion, Education, &c.—Tasmania contains representatives of all the principal religious bodies, but unfortunately no census of them was taken in 1881, and it is consequently impossible to furnish any very exact account of their relative strength in point of number. The Church of England is under the government of a bishop, and the number of clergy is fifty-eight. The Roman Catholic Church has also a bishop, and the various denominations of Nonconformists are under the system of government peculiar to each, and have their synods, presbyteries, and conferences, as in Great Britain; Sunday schools are numerous and well attended. It is estimated that more than half the population belong to the Church of England, the Roman Catholics numbering 22 per cent. Education is compulsory. The higher education is under a council, who hold examinations and grant degrees; elementary education is under a board. There are several valuable scholarships from the lower to the higher schools, and from the higher schools to English universities. At the census of 1881 the number of persons returned as unable to read and write was 31,080, or 27 per cent. of the population.

The first line of railway in Tasmania was opened in 1871. At the end of 1886 there were open for traffic 400 miles of railway completed, consisting of a main line connecting the two principal ports, Hobart and Launceston, and a line connecting Launceston and Deloraine, and various branches. Tasmania has a telegraph system, belonging to the government, through the settled part of tl colony.

History.—Tasmania was discovered by the Dutch navigator Tasman in 1642, and named by him Van Diemen's Land, in honour of the then governor of the Dutch possessions in the East Indies, who fitted out the expedition. It was afterwards partially explored by Captain Cook. In 1803 Lieutenant Bowen, commissioned by the government of New South Wales, landed on the east bank of the Derwent, and formally took possession of the island as a place of settlement. In the following year Colonel Collins, the first lieutenant-governor, arrived, and established tl seat of government on the west bank of the Derwent, givin_ to the spot the name of Hobart Town, in compliment to Lord Hobart, then secretary of state for the colonies. From 1803 to 1813 the island was merely a place of transportation from Great Britain and New South Wales, of which colony it was a dependency. Colonel Davey succeeded to the government in 1813, and under his administration the ports of the colony were first opened to commerce. The immigration of free settlers from England commenced in 1819, and in 1824 the colony was made an independent colony. Transportation to New South Wales having ceased in 1841, Van Diemen's Land, to which Norfolk Island had been annexed, became the only colony to which criminals from Great Britain were sent; but in consequence of the determined opposition of the colonists, it was abolished in 1853, and the name of the island changed from Van Diemen's Land to Tasmania.

TASMAN'NIA (after Tasman, the Dutch navigator) is a genus of plants belonging to the order MAGNOLIACEÆ, consisting of two Australian and one Tasmanian species. The latter, called by the colonists the Pepper-plant (*Tasmannia aromatica*), is distinguished for the aromatic qualities of its bark and the pungency of its small black fruit, which is used as a substitute for pepper. It is an evergreen shrub, growing in large masses on borders of rivers and in shady ravines, and attains a height of 12 feet. It has simple, entire, smooth, and leathery leaves, and inconspicuous flowers, crowded together in the axils of the upper leaves.

TAS'SO, BERNARDO, born at Bergamo, in 1493, lost his father when a boy, and was brought up under the care of his uncle Luigi Tasso, bishop of Recanati. In 1525 he engaged himself as secretary to Guido Rangone, who was general of the Papal troops in North Italy. A volume of Italian verses, which he published at Venice in 1531, made him known to Ferrante Sanseverino, prince of Salerno, who invited him to come to Naples, and granted him a handsome allowance. Tasso accompanied the prince in the expedition which Charles V. undertook against Tunis 1534. He was afterwards sent to Spain, in 1537, on a political mission. In 1547 an insurrection broke out at Naples against the Spanish viceroy Don Pedro de Toledo; and the Prince of Salerno having accepted a mission from the people to proceed to Germany and lay their grievances before Charles V., he was declared a rebel, and his property was confiscated. Bernardo Tasso followed his patron to France, where he fell into great pecuniary distress. He then returned to Italy, and repaired to the court of Guidobaldo, duke of Urbino, whence he passed to that of Duke Gonzago of Mantua, who made him governor of Ostiglia, in which place he died in 1569.

His principal work is a romantic poem in ottava rima, entitled "Amadigi," the subject of which is taken from the Spanish romance of Amadis de Gaula. He also wrote many lyrics.

TAS'SO, TORQUATO, son of the preceding, was born at Sorrento, 11th March, 1544. At the age of ten he was sent for by his father, then an exile, and after some time spent with him in North Italy, he went to the University of Padua to study law, for which, however, he had little inclination. At the age of eighteen he composed his first poem, "Rinaldo," in twelve cantos, which was published, and dedicated to the Cardinal Luigi d'Este, in 1566, who took him into his service, and introduced him to his brother the Duke of Ferrara, and to the duke's two unmarried sisters, Lucrezia and Eleonora. Tasso had been for some time in love with Laura Peperara, a lady of Mantua, to whom he addressed sonnets and other verses after the manner of Petrarch, styling her his Laura. But afterwards he appears to have been struck with the attractions of the Princess Eleonora, the duke's sister. Most of the sonnets and other lyrics, which are evidently intended for this object of his second love, are conceived in a respectful and somewhat melancholy strain, as if the writer felt the hopelessness of his passion. In 1571 Tasso accompanied the Cardinal d'Este on a mission to France, but left him at the end of the year. Having then returned to Ferrara, he entered the service of Duke Alfonso himself, by whom he was most graciously treated. Whilst Tasso was thus in favour he wrote his pastoral drama, the "Aminta," which was performed at court, and soon became famous through Italy. Lucrezia, Eleonora's sister, who had married Francesco Maria, duke of Urbino, wishing to hear the "Aminta," invited Tasso to her court, where he remained several months.

Towards the end of 1573 Tasso returned to Ferrara

to finish his great epic poem, "La Gerusalemme Liberata." The touching episode of Olindo and Sofronia, in the second canto, was meant to portray his own situation with regard to the Princess Eleonora; and in a sonnet to her he evidently speaks of the character of Sofronia as meant to represent herself.

Parts of the "Gerusalemme" began to circulate in MS., and the author was assailed by numerous pedantic critics. In 1577, Tasso, while in the apartments of the Duchess of Urbino, at Ferrara, fell into a passion at some impertinence of a domestic, and threw a knife at him. He was immediately arrested and confined for a short time. Later on the duke shut him up in the convent of St. Francis, with instructions to the monks to keep him confined as a madman.

Tasso now wrote many penitential letters, from which it would appear that he had assumed madness in order to satisfy the offended dignity of Duke Alfonso; but receiving no answer he escaped from the convent, quitted Ferrara, made his way to Naples, and thence to Sorrento, where his sister was married. Having by kind treatment recovered his health and spirits, he went to Rome, and afterwards to Ferrara in the spring of 1578, with the Cavaliere Gualengo. He was coldly received by the duke, and attempted in vain to procure an interview with the Princess Eleonora and the Duchess of Urbino. In October, 1578, he went to Piedmont under an assumed name in the course of many wanderings; but he became known, and received a flattering reception from Charles Emmanuel, its sovereign. Tasso, however, still had his eyes and his heart fixed upon Ferrara, and encouraged by letters from the Cardinal Albano, he arrived there, 21st February, 1579, on the eve of the arrival of Margarita Gonzaga, the new bride of Duke Alfonso.

The duke refused to see Tasso, the princesses also denied themselves, and the court attendants treated him with rudeness and contempt. The poet became furious; he uttered impertinent words against the duke and the whole house of Este, which being reported to Alfonso, the latter gave orders that he should be confined in the hospital of St. Anna as a madman.

Tasso remained a prisoner till July, 1586, and appears at first to have been treated very harshly. He wrote to the duke and to the princesses, but in vain. At last he grew more tranquil, and greater leniency was shown him. He was visited in his confinement by various distinguished persons, and in the meantime was busy writing or correcting his poetical compositions, which were printed at Venice, but very inaccurately, to his great annoyance. At last Vincenzo Gonzaga, son of the Duke of Mantua, obtained, in July, 1586, permission for Tasso to accompany him to Mantua; and the poet, to make some return for the kindness which he experienced from the house of Gonzaga, completed his tragedy of "Torrismondo," and dedicated it to his liberator, on his accession to the ducal throne in 1587. In 1588 he wandered to Naples, and in 1589 to Rome; and then accepted an invitation of the Grand-duke Ferdinando de' Medici to visit Florence in the spring of 1590, where he was received with great honour by the court and other persons of distinction.

Towards the end of the same year he returned to Rome, and in 1591 to Naples, and there began to re-write his epic poem, under the title of "Gerusalemme Conquistata," in order to satisfy the critics. However, this last version is never read. Meanwhile Cardinal Cinzio prevailed on Pope Clement VIII. to grant the poet the honour of being crowned with the laurel-crown in the Capitol, as Petrarch and others had been, and Cinzio hastened to announce the news to Tasso, who assented with some reluctance, and took leave of his friend Manso, with a foreboding that it would be his last farewell. He arrived at Rome in the beginning of 1595, was lodged in the papal palace, and treated with the greatest regard. Cardinal Cinzio became indisposed; the pageant was postponed; and then Tasso himself fell ill. He felt from the first a conviction that this illness would prove fatal; and he was, at his own wish, removed to the monastery of St. Onofrio, on Mount Janiculum, where he devoted his remaining days entirely to religious practices. He expired 25th April, 1595, and was buried in the Church of St. Onofrio, with a plain slab over his tomb, which bears the simple inscription, "Torquati Tassi ossa hic jacent."

His fame as a great poet rests upon his "Gerusalemme Liberata." His lyrical compositions are numerous, and many of them exquisite both in language and sentiment. His "Gerusalemme Liberata" has been translated into most European languages. There are English translations by Fairfax, Hoole, Broadhead, Hunt, and Wiffen. It has also been paraphrased into several Italian dialects. (Milman's "Life of Tasso," London, 1850.)

TASTE. The organs of this special sense are certain parts within the cavity of the mouth, obviously so disposed as to take early cognizance of matters about to be swallowed, and to act as sentinels for the remainder of the alimentary canal, at the entrance of which they are situated. Their special endowment, aided by an exquisite development of common sensibility, enables them to give timely notice of any acrid, caustic, or nauseous quality, of any undue temperature, of any inconvenient hardness, irregularity, size, or sharpness in the material submitted to them, and thus to protect the stomach against the intrusion of many hurtful agents. These organs, moreover, establish for our appetites a scale of liking and disliking, and they superadd a discriminative pleasure to the enforced assuaging of hunger.

The membrane of the mouth and throat is the seat of this function, but it is not alike seated in all parts.

A small portion of the soft palate, just above the base of the uvula, the remotest part of the back of the tongue, where it corresponds to the isthmus of the palate, and the entire circumference of the tongue are so endowed; while the internal surface of the cheeks, the hard palate, the gum, the remaining parts of the soft palate and of the tongue are entirely destitute of it. Thus, those parts of the tongue with which, in sipping or in masticating, the food would have contact (its borders, and, most eminently, its tip), are gustative; and the property is shared, though in a less degree, by the lingual and palatine surfaces of the isthmus through which the food enters the sphere of involuntary actions.

The nerve specially endowed with the sense of taste is a branch of the third part of the fifth cerebral nerve, called, from its function, gustatory; but it seems possible to some physiologists that the glosso-pharyngeal nerve shares this property. The gustatory nerve is distributed to the papillary surface of the tongue, especially along its borders and tip; the lingual part of the glosso-pharyngeal nerve is restricted in its distribution to the posterior part of the tongue, where it supplies the mucous surface exclusively.

The sensation of taste admits of an immense variety of modifications which no language can express. The following classification of the impressions produced by substances taken into the fauces may serve to distinguish the chief varieties of tastes:—

1. Where sensations of *touch* alone are produced, as by rock-crystal, sapphire, or ice.

2. Where, in addition to being felt upon the tongue, the substance excites *sensation in the nostrils*, as, for instance, tin and other odorous metals.

3. Where, besides being felt upon the tongue, it produces sensations of *taste*, as, for instance, sugar and salt.

4. Where the substance is felt on the tongue and tasted by it, and in addition excites a sense of flavour in

the nostrils, as, for instance, bread, manna, and other substances. •

Flavour, then (in distinction from *taste*), can in correctness be attributed only to bodies possessed of some aroma or volatility; and by alternately smelling and tasting such, and by contrasting their impression with that produced by a simply sapid substance (mustard and salt can illustrate the two cases), it will be noticed that flavour is but an odour, which, from its affecting a comparatively unpractised part of the olfactory apparatus, is at first imperfectly and obscurely recognized.

TAS'TO SOLO ("key alone"), a direction in music for the organ, &c., when a melody is required to be played alone, without accompaniment. In old music, where the accompaniment is not written down, but is indicated by figured bass, the direction was necessary, and is constantly found.

TATE, NAHUM, writer of English psalmody, was born in Dublin in 1652. He was educated at Trinity College, whence he removed to London to follow the profession of literature. On the death of Shadwell in 1690, the interest of his friends procured him the post of poet-laureate, which he held until his death, 12th August, 1715. He is said to have been an intemperate and improvident man, and to have died in the privileged precincts of the Mint, where he had taken refuge from his creditors. He is chiefly known for his version of the Psalms, written in conjunction with Nicholas Brady, which speedily took the place of the rendering of Sternhold and Hopkins, and was placed as the authorized metrical version at the end of the "Book of Common Prayer." Tate also wrote a considerable portion of the second part of "Absalom and Ahithophel," ten plays, a prose collection of "Memorials for the Learned" (1686), and a large number of birthday odes, and occasional poems.

TA'TIAN, one of the earliest defenders of Christianity against the attacks of the philosophers, was born in Assyria, of a pagan family, in the first half of the second century A.D. He studied rhetoric and philosophy, and practised as a teacher at Rome, where he met with Justin Martyr, through whose influence he was converted to Christianity about the year 162. He became subsequently a diligent expounder of the Old and New Testaments, and he wrote an apology for Christianity entitled, a "Discourse to the Greeks." This appears to have been written during the lifetime of Justin Martyr, and it is quite orthodox in its tone, but after the death of Justin, Tatian developed some peculiarities of doctrine which were branded as heterodox and heretical. Thus he forbade all bodily indulgence, and commanded his followers to adopt celibacy, to refuse all luxuries, and to substitute water for wine in the celebration of the Eucharist. He also separated the creator of the world from the Supreme God, regarding the law as the work of the former and the gospel as proceeding from the latter, and he further maintained that Adam was among the damned—an opinion peculiarly objectionable to the orthodox party. Tatian was a voluminous writer, his works, including the first attempt at a harmony of the Gospels, "To dia tessaron," but the only one that has come down to us is the "Apology" referred to, which has been preserved along with the works of Justin Martyr.

Since the invention of printing it has passed through many editions, the earliest being that of Zürich in 1546, and the best that by Worth, 8vo (Oxford, 1700).

TA'TIUS, TI'TUS, was King of the Sabines when Romulus founded Rome. It was he who led his Sabines to the attack on Rome when Tarpeia's treason admitted them to the citadel, and the cause of the war was the treachery by which Romulus had gained wives for his followers by stealing the women of the Sabines. These same women had been kindly treated by their captors, however, and flung themselves between the combatants. A treaty was sworn, and Tatius reigned on the captured Capitol, while Romulus was king on the Palatine. The joint commonwealth thus continued till Tatius was assassinated by a neighbouring tribe whom he had wronged, and Romulus thereafter reigned alone.

TAT'LER, the famous newspaper which Steele founded on the 12th April, 1709. It was a penny paper, appearing thrice a week, and with a small part of its space devoted to genuine news, the bulk of it being devoted to some essay or tale, such as Steele alone could write. After eighty numbers Addison returned to London, whence he had been all this while absent. Steele at once enlisted his pen, and it quickly appeared that in many qualities Addison was superior even to the delightful ex-dragoon. The popularity of the *Tatler* was great, and it created an era in literature. It closed with No. 271 on the 2nd January, 1711, and was almost at once reissued in four volumes. No sooner had Isaac Bickerstaff ceased to write his lucubrations in the *Tatler* than the more dignified nameless *Spectator* appeared. The first number of this still more famous print appeared 1st March, 1711. See SPECTATOR.

The pseudonym of Isaac Bickerstaff was the result of a joke. A certain Partridge had an almanac wherein he prophesied of various things. Dean Swift, to ridicule his pretensions, prophesied in a sham rival almanac by a pretended Isaac Bickerstaff the death of Partridge. And in due course he published "The accomplishment of the first of Mr. Bickerstaff's predictions, being an account of the death of Mr. Partridge," &c. The angry almanac writer protested that he was alive. Just then the *Tatler* appeared, and Steele caught up the jest, served up a letter from the supposed Bickerstaff reasserting the death of Partridge, and assuring him that if he were not dead he ought to be for very shame, for "when the art was gone, the man was gone." The name was retained all through the long career of the journal.

TATTOO', the signal for troops to enter quarters for the night, was undoubtedly once a drum-beat, since the popular phrase for drumming with the fingers is "beating the devil's tattoo." The word was originally *tap-too*, and meant the beat of the drum, warning that the taps of the public-houses should be struck *to*, *i.e.* closed. Phrases survive in Dutch, &c., with this meaning, and the German word for tattoo is still *zapfen streich*, or tap-stroke.

But the tattoo is now a trumpet call rather than a drum call. The usual mode in English regiments is to begin about twenty minutes before closing the gates with the "first post," a trumpet call. Then a peculiar beat and roll of the drum follows. After this the drums and fifes march to and fro (or the pipers if of Scotch regiments) playing quick-steps. Finally, God save the Queen is played; then the "second post" sounds, and every one turns in. In Germany tattoo is played by the whole band, and not merely by drums and fifes. This accounts for Beethoven's use of the word to signify a short orchestral march.

TATTOO'ING is the name usually given to the custom common among many uncivilized tribes of marking the skin by punctures or incisions, and introducing into them coloured fluids, so as to produce an indelible stain.

Herodotus, in describing the habits of the Thracians, says that to be tattooed or marked (Gr. *estichthai*) was an emblem of rank, and the want of it indicated meanness of descent (v. 6). Tattooing was also practised by the Arabs and other Shemitic peoples, but it was forbidden by the Levitical law to the Jews (Lev. xix. 28).

Isidore, in speaking of the Picts, whose name he derives from their dye-stained skins, tells us that the painting was done by squeezing out the juice of certain herbs upon the body, and puncturing the figures with a needle. The practice was continued to some extent during the whole of

the Anglo-Saxon period, and is among the English vices reprobated by William of Malmesbury after the Norman conquest. European sailors are still in the habit of printing anchors and other marks on their arms, a practice which may be regarded as a relic of tattooing.

In modern times the custom has been found to exist in most of the islands of the Pacific Ocean, and among many of the aboriginal tribes of Africa and America, as well as, on a limited scale, in the East. The native chiefs of New Zealand formerly covered the face and the whole of the body with a variety of very elaborate symmetrical figures. In Polynesia tattooing is done by puncturing the skin with sharp-pointed instruments of bone till the blood flows, and then rubbing in charcoal. The age for tattooing the males varies from eight to ten years up to about twenty; the females have only the face slightly tattooed.

TAUCH'NITZ, KARL CHRISTOPH TRAUGOTT, a distinguished German printer and publisher, was born of humble parentage at Grosspardau, near Leipzig, in 1761. He was brought up as a printer, and by great exertions succeeded in establishing a small business of his own at Leipzig, which he gradually enlarged until it became one of the most thriving and respected publishing establishments of Germany. His books, at the time of their publication, were unrivalled for their correctness, fine typography, and cheapness, qualities which gained for them a European reputation. Tauchnitz was the first (1816) to introduce stereotyping into Germany, and he was the first printer who used stereotype plates for the printing of music. Among the more celebrated of his books are an edition of Homer issued in 1828, a stereotyped edition of the Hebrew Bible, and an edition of the Koran in the original Arabic. He also published some beautiful editions of the classics. He died at Leipzig, 14th January, 1836, his business being continued by his son, Karl Christian Philip Tauchnitz. A nephew of the elder Tauchnitz, Christian Bernhard Tauchnitz, who was born at Schleinitz, near Naumberg, 25th August, 1816, the founder of the publishing firm of Bernhard Tauchnitz, is also famous as a printer. From his firm have issued many important works of a learned character, and they are also celebrated for their editions of "British Authors," begun in 1842, and of "German Authors," begun in 1866, and which has ever since been regularly continued.

TAU'LER, JOHN, a celebrated German mystic and preacher, was born at Strasburg in 1290. About the year 1308 he renounced a considerable fortune to join the Dominicans, and afterwards studied theology in the University of Paris. On his return to Strasburg he became acquainted with Master Eckart, whose philosophical mysticism had much influence upon him, and he entered into close relations with the society of the "Friends of God," at that time numerous on the Upper Rhine and in Swabia and Bavaria. The members of this society were distinguished by a spirit of deep mystical piety, and in a time of great confusion in church and state, owing to the conflict between the German Empire and the court of Rome, they devoted themselves to works of devotion and charity, as distinguished from ritual and ecclesiasticism. Tauler began to preach at Strasburg in spite of the interdict of Pope John XXII., and soon rose to eminence in his vocation, great crowds flocking to hear him. His fame also attracted one visitor, a Waldensian layman, the celebrated Nicholas of Basel, who had some conferences with him, with the result that Tauler, then over fifty years old, and in the enjoyment of much fame as a teacher, was led to retire for contemplation and study for a period of two years. Emerging from this retirement with renewed zeal and increased knowledge, Tauler spoke with such fervour and power as to deeply stir the hearts of the people, and his courage being equal to his zeal, he did not hesitate to rebuke the sins of the clergy, not sparing even the Pope himself. The higher clergy were enraged and sought to silence him, but the magistrates of the town protected him, and many of the priests rallied round him and assisted him in his labours. In 1348, when the Black Death visited Strasburg, Tauler, with two other priests, defied the pope's interdict in order to minister to the dying people the last sacraments of the church, and in a letter addressed to the higher clergy he declared, "Christ died for all men, and no one can be kept by the Pope out of heaven who dies a true Christian. He who has a true faith, and is guilty of no other offence than one against the Pope's person, is no heretic on that account." This bold statement resulted in his banishment, but after a stay of some years at Cologne he returned to Strasburg, where he laboured until his death, which took place in 1361.

Considered as a preacher, Tauler must be placed in the first rank of Christian orators, and to his learning and eloquence he added the influence of a life of saintly piety, fearless courage, and heroic self-abnegation. His mysticism, too, was rather of an active than a passive nature, and while he retained all the chief doctrines of the church in which he had been trained, he possessed a breadth of view which raised him far above his age and his contemporaries, and justly earned for him his title of "Doctor Illuminatus." Many of his sermons were preserved in MS., and they were first printed at Leipzig in 1498, a fine edition of his whole works being issued in folio at Basel in 1521. Among later editions are the "Predigten" (three vols., Frankfurt, 1826; new edition, Prague, 1872); and "Nachfolgung des armen Lebens Christi" (Frankfurt, 1833, edited by Denifle, Munich, 1877). See also Miss Susannah Winkworth's "Life and Times of Tauler," with translations of some of his sermons (London and New York, 1857); and Schmidt's "Nicholaus von Basel, Bericht von der Bekehrung Taulers" (Strasburg, 1875).

TAUN'TON, a market-town and municipal and parliamentary borough in Somersetshire, is 163 miles W.S.W. from London by the Great Western Railway, 40 miles S.S.W. from Bristol, and 30 miles N.N.E. from Exeter. The town is only 141 miles from London by road. It is situated in a fertile vale called Taunton Dean, and is about a mile long. The principal streets are wide, well paved, and kept unusually clean; the houses are of brick, and of respectable appearance. The Tone, from which the town takes its name ("Tonetown"), a tributary of the Parrat, flows on the north-west side, and is crossed by a stone bridge of two arches. It receives several affluents within or very near Taunton. The market-house stands in a spacious open area called the Parade, and is a brick building of considerable size; the upper part comprises the guildhall and an assembly room, and the lower portion consists of an arcade on each side, in one of which the corn market is held. On the west side of the Parade there is a handsome building of the Ionic order, the upper part of which is appropriated as a library, museum, and reading-room; and underneath, and in the rear, are the markets for fish, poultry, dairy produce, &c. The town also contains two old churches in those of St. Mary Magdalene, a spacious and very handsome edifice, specially distinguished for a beautiful florid Gothic tower, in four storeys, 153 feet high, originally built in Henry VII.'s reign, and rebuilt in 1862, and of St. James, of the thirteenth century, with another good tower, rebuilt in 1869; several other churches and chapels for dissenters; Roman Catholic church and two convents; barracks; county buildings, including very handsome assize courts, with statues of the following Somersetshire worthies—Pym, Locke, Blake, Bishop Ken, Young, Speke, and Byam; town-hall; Bishop Fox's free grammar-school, founded 1522, for which handsome new buildings were erected in 1870, and the benefits of which are now much more utilized than formerly; Wesleyan Collegiate Institution, built 1847, in the Tudor style, 250 feet long;

West of England College for Dissenters, opened in 1869, a neat semi-Gothic building, with accommodation for 150 boarders; school of industry; Taunton and Somerset hospital and eye infirmary, and several hospitals and almshouses. The inhabitants formerly carried on extensive manufactures of silks and woollens, but these are now very insignificant, and the chief trade is in agricultural produce. The town is surrounded with gardens, orchards, and rich meadows. The spring assizes and Michaelmas quarter sessions are held at Taunton. It is the head of an archdeaconry, and the seat of a county court.

The former privileges of Taunton as a municipal borough, which were forfeited in 1792, were restored to the town by a charter granted in 1876, under which it is now governed by a mayor, six aldermen, and eighteen councillors. It formerly returned two members to the House of Commons, but the Redistribution Act of 1885 reduced it to one. The population in 1881 was 16,614. Taunton is of great antiquity, and appears, from the discovery of urns with coins, to have been a Roman station. About 700, Ina, king of the West Saxons, built a castle here. Near its site another castle was built by William the Conqueror. It figures in English history, and during the Civil War, when held by the parliamentarians under Robert Blake, made a celebrated defence against the royalists. The Duke of Monmouth was proclaimed king at Taunton in 1685, and the inhabitants in consequence suffered much from the cruelties of the notorious Jeffreys during his "bloody assize."

TAUN'TON, a flourishing town of Massachusetts, in the United States, is on the Taunton River, 35 miles south of Boston by rail. Its population in 1840 was 7645; in 1880 it had increased to 21,213. It is handsomely built, and in the centre is a beautiful inclosure, called "Taunton Green." The principal buildings are—the numerous churches (among which the Trinitarian Congregational, the Baptist, and the Episcopal, are fine specimens of architecture), the court-house, banks, academy, library, &c. The Second State Lunatic Hospital, a splendid structure, with three domes, is situated about a mile from the Green. The manufactures of Taunton are extensive and various, consisting of Britannia ware, locomotives, steam-engines, cotton and other machinery, nails, tacks, brads, cotton goods, and numerous other articles. Shipbuilding, formerly an important branch of business here, is being restored. Taunton has a considerable coast trade, and in the importation of breadstuffs ranks as the third town in New England.

TAU'RICA CHERSONE'SUS was the ancient name of the peninsula which jutted out southwards from European Sarmatia, between the Pontus Euxinus (Black Sea) and the Palus Mæotis (Sea of Azov); it is now called the CRIMEA, and its physical features are described in that article.

TAU'RIDA, a southern government of European Russia, bordering on the governments of Kherson and Ekaterinoslav, the Sea of Azov, and the Black Sea. The area is 24,537 square miles; the population 950,000, mostly Tartars. The government includes the Crimea (the *Tauris* of the ancients, whence the name Taurida), which comprises nearly one-third of the area and population, and contains the capital Simferopol, and the principal port and naval station Sebastopol. [See CRIMEA.] The northern part is a dry elevated country, with a sandy soil impregnated with salt, and without trees, but with some rich valleys that produce luxuriant herbage. Agriculture is little attended to, and the country is chiefly devoted to rearing cattle. A few small streams flow into the sea of Azov, but the only river of importance is the Dnieper, on the north-west frontier. Numerous tongues of land formed by alluvial deposits project from the south coast, the most extensive of which lies south of the estuary of the Dnieper, and was anciently called *Achilleos Dromos*, or Race-course of Achilles. Salt, saltpetre, and naphtha are abundant, and marble is quarried.

TAU'RINE, a neutral substance, containing sulphur of animal origin, obtained from the taurocholic acid of bile. It does not exist in healthy bile, but is sometimes present when it is in a diseased state. It is also found in some of the mollusca and fishes, in the oyster, and in the blood of the shark and the ray. It is obtained in large, colourless, monoclinic crystals, soluble in water, but insoluble in alcohol. The formula is $C_2H_7NSO_3$.

TAURIS'KOS, a Greek sculptor of Tralles, in Caria, Asia Minor, who, with his brother Apollônios, made out of one vast block of marble the celebrated colossal group of "Zêthos, Amphiôn, and Dirkê tied to the Bull," now in the museum at Naples, and formerly known as the Toro Farnese, or Farnese Bull. It and the Laocöon are the two most important groups of ancient sculpture; both were carried to Rome from Rhodes. The Farnese Bull was in the collection of Asinius Pollio at Rome, in the time of Augustus. It was found in 1546, much knocked about, in the baths of Caracalla at Rome, and was appropriated by the Farnese family, who had so many of the then discovered Palatine treasures. They had it unskilfully restored by the sculptor Gio. Battista Bianchi. It was removed from Rome to Naples about the year 1786, and was a second time repaired at Naples. A fifth figure of the group, that of Antiopê, is a modern addition, the feet only being ancient. Michelangelo, who added it, has given Antiope a pleading expression, as if she would willingly see her mistress saved; but this is a sentiment we do not find among the ancients. The group, even without this, is not as it was carved; for an ancient restoration, possibly when it was put up as the chief ornament of the great baths of the Emperor Caracalla altered the position of Dirkê. An antique gem shows that she ought to be held by the hair by Zêthos. At present one is inclined to wonder why Dirkê does not escape. The group is figured in Plate VI. of the plates on SCULPTURE. The queen has condemned her slave, Antiopê (seen behind), to be tied to a wild bull. Mazeppa-fashion, for a fault she has committed, the order being given to Zêthos and Amphiôn. On learning from the horrified shepherds that Antiope was their mother, which they had not known before, they took the dreadful revenge upon Dirkê of inflicting upon her the fate she destined for another.

TAUROCHOL'IC ACID, or Choleic Acid, is found as taurocholate of sodium in bile, especially pure in that of the dog, which is the best source. It is also found in the bile of serpents, fishes, fowls, sheep, and oxen, generally occurring with glycocholic acid. It crystallizes in silky needles, having the formula $C_{26}H_{45}NSO_7$. It is soluble in water and alcohol, but not in ether. When boiled with water it is converted into taurine and cholic acid ($C_{24}H_{40}$ It combines with bases forming crystalline salts, of which the best known is taurocholate of sodium ($C_{26}H_{43}NaNSO_7$), which forms the principal constituent of ox bile.

TAU'RUS (the Bull), the second constellation of the zodiac. Its position in the heavens, surrounded by Aries, Eridanus, Orion, and Perseus, is easily obtained by the manner in which its bright star Aldebaran is connected with the belt of Orion.

The figure is only a part of a bull, the head, shoulders, and fore legs. Aldebaran and the Hyads form the forehead and eye, and the Pleiads are in the shoulder. But Aratos must have drawn the figure differently, for he puts the Pleiads in the knees. See Plate CONSTELLATIONS, Northern Hemisphere, opposite the figure IV.

TAU'RUS, MOUNT, according to the later Greek geographers, was a great chain of mountains which extended nearly due east and west from the shores of the Ægean to those of the supposed Eastern Ocean, and divided

Asia into two parts, within and without the Taurus. Their notions respecting this chain were by no means accurate.

The chain of Taurus, properly so called, commences at the south-western point of Asia Minor, and proceeding eastward parallel and near to the Mediterranean, it incloses between itself and the coast the narrow strip of land which formed Pamphylia and Cilicia. At the river Pyramus the chain divides into two—that of Amanus, which proceeds to the east, dividing Syria from Asia Minor, and the continuation of Taurus, which runs north-east, along the south-east side of Cappadocia, across the Euphrates into the northern part of Armenia, where it joins Mount Masins.

In Cappadocia the Taurus throws off a great branch called the Anti-Taurus, which passes through the middle of Cappadocia, north-east to the sources of the Halys, and thence east to the Euphrates. Its modern name is *Alidagh*. At Sebaste (Siwas) this chain joins that of the Paryadres (Chishcshi), which extends north-east as far as the mountains of Ararat. In modern geography the whole range from the south-west of Asia Minor to Ararat bears the name of Taurus, which is probably merely a form of a root that occurs in several languages, meaning mountain.

TAURYL'IC ACID, an acid obtained from urine. It is a colourless oil, having the odour of castor. The formula is $C_7H_8O_7$. It boils at about 190° C. (374° Fahr.)

TAU'TOG or **BLACKFISH** (*Tautoga americana*) is a fish belonging to the WRASSE family (Labridæ), common on the Atlantic coasts of temperate North America. It is much esteemed for food in the United States. The tautog has an oblong compressed body, covered with small scales, which are rudimentary on the cheeks. The jaws are armed with a double row of strong conical teeth. It attains a weight of 12 or 14 lbs., and is black above, whitish on the belly. It is caught by hook and line on rocky bottoms.

TAVERN SIGNS. See SIGNS.

TAV'ISTOCK, a market-town of England, in the county of Devon, 11 miles north from Plymouth, 34 W.S.W. from Exeter, and 263¾ from London by the Great Western Railway, is situated on the north-west bank of the Tavy, in a narrow valley, from which the ground rises steeply on both sides to the height of several hundred feet. The river is crossed by two bridges within the town. Tavistock belongs almost entirely to the Duke of Bedford, and has been very much improved, chiefly at his expense. It is now thoroughly drained and amply supplied with water, and has excellent covered market buildings and many new houses. It depends chiefly upon the copper and tin mines, which are successfully worked in the neighbourhood, among which are the Devon Great Consols, whence nearly all the arsenic raised in England is derived. There are some small manufactories of serges and woollen cloth, an iron-foundry, several malt-houses, and a brewery. The parish church is an ancient and spacious edifice, with a tower at the west end resting on arches. There is another church and several dissenting chapels. The town has a guildhall, corn market, and covered markets, and college for the sons of naval officers. The population in 1881 was 6914. Tavistock is a place of great antiquity, and was formerly noted for its abbey, which was the most important in Devonshire. At the dissolution in the reign of Henry VIII., when the revenue amounted to upwards of £900 per annum, it was bestowed on John Lord Russell, in possession of whose descendant, the Duke of Bedford, the property still remains. Sir Francis Drake, the famous navigator and naval commander, belonged to the immediate vicinity of Tavistock, and a colossal statue of him was erected in the town in 1886.

TAX, TAXATION. The word tax comes to us through the French *taxer*, from the Latin *taxare*, to handle, value, appraise, tax. Its general meaning is an impost raised by authority to meet the expenses of state or local government. Taxation, in this connection, is defined as the act of levying a tax, or of imposing taxation.

The practice of raising taxes is probably almost as old as that of organized government; although, in ancient as well as modern times, kings have often derived large revenues from their personal estates, as well as from fines and confiscations. It is singular how small a place is assigned to taxation in ordinary history. Few have cared to devote their time to a chronicle of its details and incidence. Yet, "a force which," to quote a recent writer, "has, among other results, excited dangerous revolts, has split and severed mighty empires, has brought about the decline of kingdoms, has moulded the forms of the dwelling-places, has modified the clothes, and at times even excited the diseases of nations, must be admitted to be one of the most powerful, as well as one of the most all-pervading of the influences which sway the shifting currents of human life."

Taxation, like most of the arts of government, was carried to a considerable pitch of development by the Romans, and it is interesting to note how many of the expedients of modern finance-ministers have been borrowed from Roman administrators. Customs duties (with a difference in favour of the products raised or manufactured in the provinces), and a most elaborate system of excise, which comprehended whatever was sold in the markets or by public auction, were introduced by Augustus. He also imposed a tax of 5 per cent. on legacies and inheritances over a certain value, which was levied upon all but the nearest of kin on the father's side (until the time of Justinian, when the exemption was extended to the relations on the mother's side also); and was one of the most fruitful sources of revenue.

The Roman conquest of Britain was the means of introducing into this country, with other appliances of civilization, a regular system of taxation. Some of the taxes had to be paid in kind and delivered at the imperial granaries. In such cases the distance of transit, and the bad state of the roads, often made the cartage of the produce a more severe burden than the impost itself, and seems to have been a frequent subject of complaint. The flocks and herds which formed the principal property of the Britons were charged at so much a head by means of a tax termed *scriptura*, from the inscription of the number of head of cattle in the roll of the tax-gatherer. A poll-tax also seems to have been occasionally levied, but little clear information is to be found about Roman taxation in Britain, as the whole system vanished with the last of the legions.

The several small kingdoms which arose out of the strife and confusion that followed the English conquest of Britain, all had their royal demesnes and folk or public-land; and when the country became subject to one king, the demesnes of the various kinglets became his, while the folk-land, which was directly subject to him as territorial lord, became virtually part of the royal demesne. Out of the produce of what had been the folk-land in each shire, the king received a certain proportion, termed *feorm fultum* for his sustenance; and with this, the produce of his demesne and fines, he was well able "to live of his own." In each shire the *scirgerefa* (sheriff), usually nominated by the king, was not only the administrator of law, but acted as king's bailiff over the demesne. The *hundred-gerefa*, known after the Norman Conquest as bailiff of the hundred, represented the king's interest in fines, and in the produce of the demesne and folk-land in this rateable division of the shire; while each township had its fiscal officer in the *tungerefa* or reeve. Taxes when required were imposed by the "witenagemot," or council of wise-men, but little information exists as to the details. On special occasions of imminent peril, every shire was required to contribute "ship-geld," in proportion to the number of hundreds it contained, for providing and equip-

ping a fleet. The well-known tax called "Danegeld," was first imposed in 991 to bribe away the pirates, and £10,000 was raised by a levy of about a shilling on every hide (from 100 to 120 acres) of land. The Danish freebooters naturally soon returned, and every few years a larger amount had to be raised to get rid of them, until in 1018 no less than £72,000 was paid in this way, of which over £10,000 was contributed by London alone. Kings never lightly abandon a successful expedient for getting money. So Danegeld continued to be collected as revenue after the Danish invasions had ceased, and although abolished by Edward the Confessor, the tax was revived by William the Conqueror, became a regular impost under Stephen, and only disappeared finally after 1168. "Fumage," or the hearth-tax, a kind of impost usually found among the fiscal traditions of communities in remote ages, was known in Anglo-Saxon times, and is also referred to in Domesday Book. It seems to have been a customary payment to the king for every hearth in all houses but those of the poor.

After the Norman Conquest the royal demesne included not only that of Edward the Confessor, but was increased by large additions from confiscated lands. In 1086 it included, according to Domesday Book, 1422 manors or lordships, besides farms and lands in Middlesex, Shropshire, and Rutland. London and most of the towns in the kingdom formed part of the demesne. The rural tenants of the crown-lands at first contributed in kind for the supply of the royal table, but under Henry I. this liability was exchanged for an annual rent, collected by the sheriff of the county. This officer also gathered the rent of the towns, except those which had been granted to some great lord or prelate. The case of collecting rent from the towns frequently led to their being over-rated, and accounts for the eagerness of the townsmen to make separate terms for themselves, and escape the sheriff's grasping hand, by obtaining royal charters, granting the towns to them at a rent separate from that of the county.

The feudal system of land-tenures, gradually introduced by the Conqueror, will be found described under its proper head. It will only be necessary to show here what an important source of revenue it was, even up to the outbreak of the great Civil War. The right of wardship, in particular, was stretched to the utmost in order to obtain money. On the death of a tenant-in-chief, the king came in to ward off intruders, until the heir appeared to claim the lands and to do homage. For this a year's profits, termed *primer seisin*, were due. When the heir was a minor the king held possession of the lands and provided a substitute to perform the services due from him until he came of age. When the ward was a female the king was entitled to select a husband for her. This *maritigium*, or right of bestowal in marriage, was extended eventually to men. The Exchequer Rolls bear evidence as to the various ways in which these rights were made a source of income. Royal wards were actually sold for money. Perhaps the highest-priced ward of which the Exchequer Roll tells us was Isabell, countess of Gloucester, for whom, with all her lands and knights' fees, Geoffrey de Mandeville gave King Henry III. 20,000 marks. Fines were often paid by both male and female wards to escape from a proposed match, or to marry according to their own liking. Even marriage did not always completely extinguish the rights of the sovereign in these matters, as witness the following entry:—"The wife of Hugo de Nevill gives to the king 200 hens for permission to sleep with her husband for one night; Thomas de Sandford being pledged for 100 hens." The system of exacting fines on every possible occasion gradually extended itself. Thus, "The Bishop of Winchester owes a tonell of good wine for not reminding the king (John) about a girdle for the Countess of Albemarle;" and "Robert de Vaux fines in five of the best palfreys that the same king would hold his tongue about the wife of Henry Tinel."

Numerous other charges were made in connection with the right of wardship, which we must pass over. The sale of public offices, among others that of sheriff, was another means of filling the royal exchequer. The grant of liberties and charters to towns was also a frequent source of revenue. For instance, in the fifth year of Stephen we find the Londoners paid 100 marks of silver for the right to choose their own sheriff. Worst of all, the sale of royal protection and justice was freely resorted to as a means of getting money. The Exchequer Rolls abound in payments to have right done or for the expedition of justice, and counter payments by defendants to have writs denied or proceedings delayed or stayed. This scandalous abuse of royal authority was formally abandoned in the Great Charter, though it by no means ceased then. Indeed in less direct ways the sale of justice was carried on in a much later age, through the heavy taxes on legal proceedings, and something yet remains to be done before the famous article of that charter, "Justice shall not be sold, refused, or delayed to any one," is fulfilled in the spirit as well as in the letter.

The feudal *aids*, which at first were more or less of the nature of voluntary contributions, were gradually converted into burdensome imposts and rigorously exacted. By Magna Carta these were only allowed to be imposed in three cases—viz., to ransom the king's person, to equip his eldest son as a knight, and to provide a dowry on the marriage of his eldest daughter.

The rule of knight service in person did not last long. The feudal array was difficult to manage; great barons arrived late at the muster of the host; all sorts of disputes and wranglings occurred about place and precedence; the strict limitation of the term of compulsory service to forty days fixed an inconvenient term to any distant expedition. Hence Henry II., at the suggestion of Thomas Becket, when preparing for his expedition to Toulouse, decided to levy a fine of money on every knight's fee instead of demanding the customary service, and took with him only his chief barons, with a few personal followers, the bulk of the army being composed of mercenaries. This tax was termed "scutage" or shield-money, and was resorted to so frequently by John that in Magna Carta the king was made to promise that neither aids (besides the three already mentioned) nor scutages should in future be imposed without the consent of the National Council. In this important concession we have the foundation-stone of our system of representative government, and in exacting it the barons began the long struggle for the right of taxation, which lasted for more than four centuries. From this point the history of taxation in England is therefore of peculiar interest, but we cannot do more than briefly describe the principal changes made in the forms and methods of taxation from time to time. In the article PARLIAMENT the reader will find some indications of how royal attempts to regain absolute power were opposed and finally overcome. For in spite of the Magna Carta arbitrary and illegal imposts long continued to be levied when opportunity offered, although frequent renewals of the charter were also solemnly made, in order to obtain legal grants. When the Assembly of the Commons became a regular part of the Parliament, they never ceased to protest against these illegal practices, and gradually tightened their hold over the national taxation, and by slow degrees over the expenditure also. For example, in 1340 certain persons were appointed by the Commons to receive the accounts of the tax-collectors. A few years later, in granting a tax upon wool, a provision was for the first time added as to the purpose to which the money should be devoted.

It is worth while to note, before going on, that at the Assize of Arms, held in 1181, to renovate and re-arm the

old national militia, the value of the rents and movables on which a tax for that purpose was levied, was assessed by chosen knights and freemen in every hundred and borough, a system which, with some necessary modifications, has been continued to the present day for purposes of direct taxation.

The tallage or special tax on the royal demesne was first termed a decima or tenth in 1194, but this rate was not invariably maintained. In 1294 London granted one-sixth of movables "in order that it might show an example to the other demesne towns." Tallage, however, gradually fell into disuse, being superseded by the more convenient form of a general tax on movables granted by Parliament, though it left its trace in the tenth, which formed the fractional part for towns and the demesne generally, as opposed to one-fifteenth for the counties outside. Some exemptions were always allowed from the tax on movables, both of specified articles and of any one whose goods did not amount to a certain small named value, which was varied from time to time. In 1334 an important change of system took place in levying this tax. In consequence of the numerous complaints caused by the old system of rating, an arrangement was made by which a fixed sum was taken from each township as a composition for the tax. Mr. Dowell says:—"Upon the basis of this settlement of the fifteenth and tenth in 1334, direct taxation mainly proceeded from this date until it became the practice to add to the grant of fifteenths and tenths a general subsidy on lands and goods. The tax in this form of a stated sum, divisible between certain districts, instead of the fractional grant on movables it purported to be, came to be regarded by the people almost as of constitutional right. When less than the sum for a full fifteenth and tenth were required, half a fifteenth or tenth was granted; and when a greater sum was required it was granted under the name of two-fifteenths or tenths as the case might be. All attempts to introduce other forms of taxation, or to disturb the settlement of 1334, almost invariably failed." Instances of this are to be found in the poll-tax, first levied in 1377, which was very unpopular. An elaborately graduated form of the tax was introduced two years later without any increase of popularity, and a third attempt to levy a poll-tax led to the peasants' insurrection under Wat Tyler. [See POLL-TAX.] A graduated income-tax, which went as low as the yearly value of £1, was tried in 1435, and again in 1450, with equal want of success, and the old methods were resumed.

From the reign of Edward III. onwards, the sums raised by means of the customs, an ancient source of royal revenue [see CUSTOMS], formed a large part—at times more than half—of the revenue of the king. The natural desire to secure as much as possible from foreigners led to taxes being imposed on aliens at high rates. In the time of Edward IV. all merchants, excepting those of Spain, Bretagne, and certain merchants of "Almagne," were charged forty shillings a year, and any alien keeping a house for the "bruying of bere" was charged twenty shillings. Further supplies for Edward's extravagances were obtained by means of loans. Sometimes he applied personally to the rich for aid; sometimes by letters, and sometimes by means of commissioners. The first method is amusingly illustrated in the following story, related by Mr. Dowell:—Edward, one of the handsomest men of the age, was a particular favourite with the ladies. A rich widow, when he asked her for a benevolence, gave him £20 down at once, saying, "By my troth, for thy lovely countenance thou shalt have even £20." The king, "who had looked for scarce half that sum, thanked her, and lovinglie kissed her," gaining her heart and purse, for she doubled the benevolence, paying another £20, either "because she esteemed the kiss of a king so precious a jewele," or "because the flavour of his breath did so comfort her stomach."

The power of calling on those who are, or are believed to be wealthy for assistance, naturally led to great abuses. Still the raising of money in this manner continued to be practised nearly a century and a half later than this date. Queen Elizabeth appears to have received many voluntary gifts from her subjects. These were offered not only by the nobility and leading gentry on New Year's Day, or other fitting occasions, but sometimes by towns collectively, and Mr. Dowell presents us with a pleasing picture of such an incident. On receiving "a handsome purse well filled" from the mayor of Coventry, "I have few such gifts, Mr. Mayor," the Queen says kindly; "it is a hundred pounds in gold!" "Please your grace," replies the mayor, "it is a great deal more we give you." "What is that?" says the Queen. "It is," the mayor replies, "the hearts of your loving subjects." And the Queen says, "We thank you, Mr. Mayor; it is a great deal more indeed." With this may be compared the money wrung by James I. from a London merchant, of whom Mr. Dowell also tells us. A rich old merchant, who had been a cheesemonger, was sent for by the council, and required to give the king £200 or to go into the Palatinate and supply the army with cheese. Being eighty years of age he consented, though it cost him more than nine subsidies, according to the valuation he stood at.

The growing power of Parliament was soon, however, to put an end to these practices once for all. The final struggle took place in the reign of Charles I., and, to quote from Mr. J. R. Green ("History of the English People"), "In February, 1641, a statute, declaring 'the ancient right of the subjects of this kingdom that no subsidy, custom, impost, or any charge whatever may be laid or imposed upon any merchandise exported or imported by subjects, denizens, or aliens, without common consent in Parliament,' put an end for ever to all pretensions to a right of arbitrary taxation on the part of the crown."

During the Civil War several fresh measures were devised by Parliament to provide funds for meeting the heavy military and naval expenditure. The principal resource was a monthly assessment on all real and personal property, which varied, according to the exigencies of the times, from £35,000 to £100,000 a month, the proportion of the latter being £70,000 a month on England, £18,000 on Ireland, and £12,000 on Scotland. This plan was found so convenient that it was continued after the Restoration, the old system of subsidies, after one or two unsuccessful attempts to revive it, being finally abandoned. The best known and most obnoxious tax imposed by the commonwealth was the excise on "beer, ale, cider, perry, and strong waters," introduced in 1643. A curious tax, known as the weekly meal-tax—a contribution from every person of the price of one meal a week—was levied by the Parliament for six years, and produced about £100,000 per annum. Shortly after the Restoration an important Act was passed formally abolishing the feudal services, which had been practically put an end to during the war. They had been estimated to yield £200,000 in the time of James I., and in lieu of them the moiety of the excise, at the rate it was now levied, "was settled on the king's majesty, his heirs, and successors." The feudatories of the crown thus escaped from all their old obligations at the cost of the community at large. About this time the revenue amounted to between £1,800,000 and £1,900,000 per annum. Of this amount the customs duties produced less than £1,000,000, the excise about £600,000, and hearth-money, the only direct tax then in existence, about £200,000. This last was taken off on account of its unpopularity, and the excise duties modified. Such excessive customs duties were imposed on tea and coffee, that no entries at all were made at the custom-house, and a system of smuggling was started which lasted for generations.

Stamp duties, which were first levied in Holland in 1624, to provide additional funds for the contest with Spain, were introduced into this country in 1671 by an "Act for laying impositions on proceedings at law," and have been ever since a large source of revenue.

Soon after the Revolution another important change of fiscal methods took place. The revenue being inadequate to meet the expenses of the war with France an Act was passed in 1692, granting an aid of 4*s.* in the pound on the true yearly value of real property, and 24*s.* for every £100 personal property (except debts stock upon land and household stuff), equivalent to 4*s.* in the pound on £6, the legal interest of money at that time. This tax produced close upon £2,000,000, or more than a third of the total revenue, and was renewed from year to year with some slight alterations in the rates charged. In 1697 a further important change was made. The annual assessments of the value of all real and personal property, with some slight exceptions, were discontinued, a fixed sum was granted for the whole kingdom, to be raised in specified quotas for each country, city, or borough therein named, towards which personal estate and official salaries and pensions (except military and naval) were to pay 3*s.* in the pound, the remainder being made up by an equal pound rate on lands, tenements, &c. That Act was renewed every year until 1797, with scarcely any difference in its provisions as to the mode of assessment, and although the amounts charged upon the counties, &c., varied according to the total sum required from the kingdom, they were always fixed in due proportions to the original quotas. The only alteration of importance is, that after the Union in 1706 Scotland was included, an addition of £18,000 to the specified amount being made as her share. In 1798 the tax was made permanent at £1,989,673, *i.e.* 4*s.* in the pound on the original valuation of 1692. Pitt's main object in doing this was to reduce the enormous mass of three per cent. stock, which then stood at about 50, by tempting landowners to redeem the tax by means of stock, which would produce a dividend exceeding the amount of the tax by one-tenth. Less than half a million was thus redeemed in the first two years, and about a similar amount since, leaving just o £1,000,000 per annum still to be raised annually. This is done by a pound-rate, varying from a small fraction of a penny in great manufacturing towns, for instance, where the value of landed property has enormously increased, to nearly the original 4*s.* in some few districts where things have remained almost stationary.

The remarkable feature about this tax is, that althougl personal property was made primarily chargeable, as we have shown, in Pitt's time, the duty raised on persona estate had dwindled nearly to nothing, and the tax annually voted under the name of land tax had become one in reality, though personalty still continued liable until 1833 It seems almost incredible that, year after year, an Ac should have been passed containing the most minute direc tions for the assessment of personal estate—that year afte year assessors should have been sworn to carry those direc tions into effect—and yet that nothing which could h called an assessment should have been made. No satis factory explanation of this extraordinary circumstanc has been offered, even by the Inland Revenue authoritie themselves. The growing public interest in the claims o the state upon the land of the country has induced us t deal somewhat fully with this particular tax and th strange anomalies that it presents.

We must now content ourselves with a bare mention o the other principal alterations in our national taxat since the Revolution, before considering the economi principles connected with the subject.

The continental wars of William of Orange led to th imposition of a tax on inhabited houses in 1696, in plac of the old hearth-tax; a malt tax in 1697; and great ıcreases in the excise and customs duties. The novel xpedients of taxes on births and on bachelors were also dopted in 1695. In each case an elaborate scale was rovided. The child of a duke brought in £30, but the poorest not in receipt of alms, were required to pay 2*s.* for very "little stranger." Bachelors over the age of twentyve, and widowers without children had to pay a yearly ax, ranging from 1*s.* to £12 10*s.* No great alteration as made in the methods of raising revenue until the close f the next century. Meanwhile the true principles of axation had been discussed by Adam Smith, and his views ad secured the warm sympathy of William Pitt, who, had e been in power during peaceful times, would probably have nticipated many of the reforms in taxation only effected in comparatively recent years. Under stress of the tremendous contest with revolutionary France, however, Pitt's name has ecome associated with some of the most searching efforts o bring everything which could be possibly considered taxble within the scope of the fiscal net. In 1799 he imosed a tax of 10 per cent. on incomes, from which only hose under £60 a year were exempt, though a reduced ate was charged on all under £200 a year. The produce of the tax in the first year was £6,046,621, or about a uarter of a million for every penny of the tax. [See NCOME-TAX.] A host of minor taxes were imposed by im, many of which still survive. The chief were taxes on windows, funerals, insurances by sea, women-servants, ace-horses, sportsmen or gamekeepers, those who used hair-powder, dogs, watches, clocks, armorial bearings, &c. A popular epigram of the time said—

> "Taxed to the bone, thy loving subjects see;
> But still supposed when dead from taxes free;
> Now to complete, great George, thy glorious reign,
> Excised to death, we're then excised again."

Pitt tried the principle of progressive charge, but without much success.

The succession of able economists—Bentham, Ricardo, M'Culloch, Senior, Mill, &c.—who followed and carried on the work of Adam Smith, drew public attention to the evils of the system of taxation in force in their time. Some important fiscal reforms, besides the repeal of the Corn Laws, were effected by Sir Robert Peel; but our existing system of taxation is mainly the work of Mr. Gladstone. Some account of the improvements introduced by him will found in the article on his life, as also in those on CUSTOMS, INCOME-TAX, and MALT.

We must now turn to consider taxation in its economic aspect. Mr. Sidgwick says, "In the view of Adam Smith, and many of his successors, the provision for the expenses of the sovereign or the commonwealth is the main and almost the sole concern of the art of political economy, or, as it seems convenient to call it, public finance." No branch of legislation is more important than the wise application of just principles in the matter of taxation. The wealth, happiness, and morals of the people are to a considerable, and often unsuspected, extent dependent upon the financial policy of their government.

Adam Smith lays down the following general maxims as to taxation:—

1. "The subjects of every state ought to contribute towards the support of the government as nearly as possible in proportion to their respective abilities; that is, in proportion to the revenue which they respectively enjoy under the protection of the state.

2. "The tax which each individual is bound to pay ought to be certain and not arbitrary. The time of payment, the manner of payment, the quantity to be paid, ought all to be clear and plain to the contributor, and to every other person.

3. "Every tax ought to be levied at the time or in the manner most likely to be convenient for the contributor to pay it.

4. "Every tax ought to be so contrived as both to take out and keep out of the pockets of the people as little as possible over and above what it brings into the public treasury of the state."

The two great divisions of *direct* and *indirect*, under which taxes are commonly classed, are, as Professor Sidgwick points out, somewhat misleading. We can only partially succeed in making the burden of either "direct" or "indirect" taxes fall where we desire. Indeed, it is a problem of great intricacy and difficulty to ascertain where the burden of a tax actually rests, and even to state a sound general principle for determining the incidence of a tax is by no means a simple matter. Mill, in speaking of a tax on profits, says that even in the case where, through the stimulus to improvements in production, profits may rise sufficiently to make up the amount taken from them by the tax, it must still "be considered as paid from profits, because the receivers of profits are those who would be benefited if it were taken off." In discussing the land-tax, however, a few pages earlier, he shows that "there is not the smallest pretence for looking upon it as a payment exacted from the existing race of landlords," although it is plain that they would benefit by its remission.

The first of Adam Smith's famous canons above quoted, leads us to that most interesting branch of our subject—the equities of taxation. The words "under the protection of the state" would seem to involve what Professor Walker calls the social dividend theory of taxation, which, plausible as it may seem at the first glance, is soon found to involve gross practical absurdities. If the benefit derived from the protection of the state be the standard, then women, children, the aged, the infirm, should be the principal contributors. The rich man can, to some extent, protect himself. If the cost of the services rendered be made the test, we have again the same result. The cost of protecting a given amount of wealth in single hands is obviously less than that of protecting it widely scattered in many hands. But, apart from these objections, it would be practically impossible to determine with any accuracy the amount of services rendered to any particular individual in the case of the most costly and important functions of government. The ordinary military and naval expenses, and the cost of modern wars, are not incurred solely or even mainly for the protection of the life and property of individuals, but for extension of empire, &c., and any attempt to apportion the advantages thus purchased among the individual members of the community would be a hopeless task. Then again, how are we to decide who profits by the sumptuous expenditure of the monarch and royal family in monarchical countries? Mr. Bagehot maintained that this "ceremonial" part of government is kept up to give a "human interest" to the dull business of governing, and to win the sympathies and stir the imaginations of the ignorant. On the other han it has been urged that the people who go to Court should be specially taxed for its maintenance.

The principle of proportioning payment to service would at any rate at first sight seem to be well applied in the fees charged in connection with proceedings at law. But, as Jeremy Bentham pointed out in his fierce "Protest against Law Taxes" (1795), it is not those who are under the necessity of going to law who benefit most, but the vast number who are enabled to enjoy in peace the rights thus vindicated at another's expense. We may mention that most of the heavy law taxes under which Bentham said justice was "denied to nine-tenths of the people, and sold to the other tenth at an unconscionable price" in defiance of Magna Carta, were repealed in the reign of George IV.

As we have seen, then, it must be regarded as hopeless to attempt the application of the "fee principle" to any large extent in taxation.

Mr. Walker, in his chapter on taxation, reaches the conclusion that "faculty, the power of production, constitutes the only *theoretically* just basis of taxation; that men are bound to serve the state in the degree in which they have the ability to serve themselves," and he illustrates this point by reference to the practice of primitive communities, where, for road-making and similar works of general concern, all able-bodied persons are required to turn out and labour, whether strong or weak, skilful or unskilful, for the same number of days. And Mr. Walker reminds us that in most European countries this principle is practically applied in regard to military service. Professor Sidgwick arrives at much the same conclusion when he says, "The obviously equitable principle is that equal sacrifices should be imposed on all."

Most economists seem to agree that a tax on income, with the exemption of a certain minimum necessary for maintenance, is on the whole the best practicable. But whether the remainder should be taxed at a uniform or progressive rate is a knotty point on which writers on finance are much divided. Some hold that the latter method in any form is sheer confiscation; others admit that it can be carried to a certain point without injury to the sense of political justice, or the instincts of industry and frugality; while some, with J. B. Say at their head, go so far as to say that "taxation cannot be equitable unless its ratio is progressive." This plan has often been put into force. It prevailed at Athens, where the citizens were divided into five classes, and taxed at different rates. In France it was adopted by the Convention in 1793, and revived at the Revolution in 1848. The system is at present in use in Prussia by means of an elaborate system of classification. In England the form of the tax has been frequently altered. In 1806 a graduated scale was imposed upon incomes between £50 and £150 a year, but limited to profits of trades, professions, and offices. A similar result has been attained since by allowing an abatement on all incomes below a certain amount. The main objection to a progressive rate is that any limit to its application must necessarily be quite arbitrary; another is the danger of checking the accumulation of capital, and thus injuring the community at large. Professor Sidgwick prefers a system of exempting savings, up to a certain amount at least, money spent in education of children, and funds devoted to objects of public utility.

Taxes on commodities are open to many objections. The strong technical reasons for concentrating them on a few articles largely consumed, in order to minimize the cost of collection, tend to throw them upon articles of common use which may almost be classed as necessaries, and which form a very much larger item of expenditure, in proportion, among the poor than among the well-to-do. This, however, may be roughly compensated, as in this country, by an income-tax upon the latter. In taxation of this nature, that upon intoxicating liquors of all sorts is, for obvious reasons, generally regarded as the least objectionable. Excise duties generally are, however, open to the economic objection that they hinder or prevent the introduction of improved methods of production. The course of manufacture is minutely prescribed in certain industries with heavy penalties for deviation from regulations which are sometimes wasteful, and must, necessarily, be to a certain extent obstructive; while improvements likely in any way to weaken the check against fraud are necessarily prohibited. Apart from this, however, the mere presence of the exciseman—as Mr. F. Field, F.R.S., ozokerit candle manufacturer, observed in speaking of the former duty on soap—made it "impossible to improve any process without its being known through him to other firms he was in the habit of visiting," and thus an important stimulus to invention was lost.

Customs duties are exposed to a similar class of objections. The cost of collection would be enormous were

every accessible place open to trade, so that instead of being left to find natural channels for itself, both the import and export trade is compulsorily restricted to customs ports. There are about 120 of these, but the importation of wine and tobacco is limited to less than half that number. The system of bonded warehouses, too, beneficial as it is in some respects, tends to hinder the development of commerce. We might give numerous instances showing the extraordinary expansion of which the trade of a place is capable when relieved from prohibitory customs restrictions—restrictions, too, only removed after the most strenuous opposition on the part of the Board of Customs. Manchester, Middlesborough, and Barrow-in-Furness are remarkable cases in point. Within about seven years of its admission to the privileges of a customs inland bonding town, Manchester stood eighth on the list of English towns in the amount of duties collected. It subsequently stood fifth, the only places which collected a larger revenue being London, Liverpool, Bristol, and Newcastle.

Thus while an income-tax, the favourite tax of the economists, is, from the inquisitorial nature of the investigations it involves, too unpopular to be made the main source of revenue, the more popular system of indirect taxes is by no means free from objection. A belief in the diffusion of taxes has, however, led economists very generally to give their approval to this system, the growth of which forms the most marked feature of the fiscal history of the present century.

The amount produced by various taxes in the United Kingdom in recent years is clearly shown in the annexed table:—

AMOUNT OF THE GROSS PUBLIC REVENUE AND EXPENDITURE OF THE UNITED KINGDOM, DISTINGUISHING THE PRINCIPAL BRANCHES THEREOF, FOR THE TEN YEARS ENDED 31ST MARCH, 1887—AMOUNTS SHOWN IN THOUSANDS ONLY.

REVENUE.

			1880							
			£			£				
Excise and Licenses,	27,710,000	27,186,000	25,218,000	25,372,000	27,171,000	26,983.000	27,048,000	26,502,000	25,442,000	25,213,000
Customs, . .	20,043,000	20,348,000	19,170,000	19,210,000	19,276,000	19,683,000	19,647,000	20,558,000	19,722,000	20,136,000
Income Tax,	5,841,000	8,865,000	9,195,000	10,776,000	12,005,000	12,166,000	10,695,000	11,923,000	15,247,000	16,111,000
	(3d. in the £)	(5d. in the £)	(5d. in the £	(6d. in the £)	(5d. in the £)	(6½d in the £)	(5d. in the £)	(6d. in the £)	(8d. in the £)	(8d. in the £
Probate, Legacy, & Success. Duties,	5,958,000	5,590,000	6,233,000	6,657,000	7,056,000	7,296,000	7,399,000	7,720,000	7,437,000	7,402,000
Stamps, . .	5,076,000	5,067,000	5,118,000	5,276,000	5,292,000	5,292,000	4,283,000	4,166,000	4,164,000	4,378,000
House Duty,	1,628,000	1 605,000	1,602,000	1,689,000	1,698,000	1,788,000	1 837,000	1,855,000	1,867,000	1,954,000
Land Tax, .	1,074,000	1,075,000	1,047,000	1,050,000	1,051,000	1,055,000	1,062,000	1,045,000	1,023,000	1,065,000
Post-office & Telegraphs,	7,356,000	7,599,000	7,987,000	8,425.000	8,744,000	9,018,000	9,505,000	9,638,000	9,908,000	10,304,009
Interest .... Pub. Loans & Suez C. Shares Purchase Mon'y	1,149,000	1,291,000	1,453,000	1,318,000	1,219,000	1,219,000	1,196,000	1,027,000	1,376,000	1,176,000
Crown Lands,	415,000	449,000	439,000	463,000	473,000	491,000	498,000	483,000	478,000	472,000
Miscellaneous,	3,909,000	4,022,000	3,815,000	4,090,000	4.034,000	4,441,000	4,310.000	3,145,000	3,019,000	2,841,000
Total Revenue,	80,189,000	83,099,000	81,277,000	84,329,000	86,019,000	89,392,000	87,480,000	88,063,000	89,684,000	91,052,000

EXPENDITURE.

	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
	£	£	£	£	£	£	£	£	£	£
Interest and Managem't of National Debt, . . .	28,413,000	28,644,000	28,763,000	29,575,000	29,666,000	29,679,000	29,651,000	9,548,000	23,450,000	27,958,000
Civil List and Civ. Charges of all kinds,	15,624,000	16,599,000	16,923,000	17,356,000	18,013,000	18,878,000	18,677,000	19,021,000	19,214,000	19,570,000
Army, . . .	15,531,000	18,143,000	16,170,000	15,966,000	16,908,000	16,254,000	17,180,000	18,655,000	17,177,000	18,429,000
Fortifications & Barracks,	800,000	450,000	250,000	—	—	—	—	—	—	—
Navy, . . .	10,785,000	11,789,000	10,231,000	10,512,000	10,561,000	10,260,000	10.729.000	11,427,000	12,661,000	13.265,000
Afghan War, India Grant,				500,000	500,000	500.000	1,000,000	250,000	250,000	
Votes of Credit and other extras, . .	3,500,000 (Credit Vote)	1,500,000 (War in	3.245.000 S. Africa)		536,000 (War, Africa)	3,895,000 (Egyptian	55,000 Expedition)	320,000 (Gord'n Exp)	9,451,000 (Credit Vote)	
Cost of Collection, . .	7,863,000	8,039,000	8,081,000	8,314,000	8,619,000	9,026,000	9,821,000	9,971,000	10,125,000	10,774,000
Total Expenditure, .	82,516,000	85,165,000	83,663,000	82,223,000	84,803,000	88,493,000	87,113,000	89,192,000	92,328,000	89,996,000

In the expenditure the "civil list and civil charges" include the expenses of the Court and of Parliament, administration of law and justice, public offices, education, and science and art grants, diplomatic and consular services, superannuations, public works and buildings, &c. The "cost of collection" includes the expense of working the postal and telegraph services, which are simply vast businesses carried on by the national government.

The increasing *productiveness* of taxation furnishes some little idea of the growth of our national wealth. William III. only succeeded in obtaining a revenue of from £4,000,000 to £5,000,000 a year; a hundred years later Pitt raised nearly £40,000,000 a year to carry on the struggle with Napoleon. Since then the yield of taxation has, on the whole, steadily increased, in spite of the repeal or reduction of a number of oppressive imposts, to which we have already

referred. The gross revenue at Queen Victoria's accession was only about £50,000,000, as compared with £90,000,000 in 1887.

Indirect taxation still furnishes the largest part of our revenue, the customs and excise duties in 1886 yielding £45,164,000, as against £44,520,000 from all other sources.

TAXATION OF COSTS. Any person who has employed a solicitor and is dissatisfied with the bill of costs presented, is entitled to have the bill checked and examined by an official, called in the Queen's Bench Division of the High Court of Justice the *master*, in the Chancery Division the *taxing master*, and in the Probate Division and in the county courts the *registrar*. This privilege may also be claimed after a bill has been paid under protest, and in either case, should the charges appear exorbitant or made for unnecessary business, they are struck out or reduced to the official scale. A client who applies to have his bill taxed is protected against an action until the taxation is complete. When more than one-sixth of the whole amount is struck off, the costs of the taxation fall upon the solicitor presenting the bill, but where the reduction is less than one-sixth the costs must be paid by the client. Costs resulting from judicial proceedings may also be taxed at the demand of the beaten party who has to pay them, and in cases where such costs have to be defrayed out of trust funds or similar property, taxation is compulsory.

TAXATION, LOCAL. The subject of local taxation is one which, since 1871, has occupied an increasing share of public interest. In that year, by the appointment of the Local Government Board, a body was for the first time obtained, whose comprehensive functions and jurisdiction [see LOCAL GOVERNMENT BOARD] enabled it in its annual report to present at one glance an insight into this most complicated subject. There are in the United Kingdom about 20,000 separate authorities interested in the raising and administering of rates, each limiting its views to its own often very diminutive bounds—such bounds frequently including only 1000 inhabitants, and sometimes fewer than 500. Yet most of these liliputian communities have their organized boards, their salaried officials, and their parliamentary powers to tax their neighbours and spend the money. A single parliamentary borough, comprising 40 square miles, 30,400 houses, and 158,000 inhabitants, who are mostly grouped along the centre of the district, and engaged in one staple trade, is divided for poor-law purposes into three parishes and two unions; for purposes of local government, into three municipal boroughs and six local board districts; and for sanitary purposes, into nine urban and two rural sanitary districts. The administration of the local affairs of the whole district occupies three mayors, sixty aldermen and town councillors, sixty members of local district boards, nine town clerks and clerks to local boards, and nine separate staffs of surveyors, clerks, auditors, &c., not to speak of two sets of guardians and clerks to guardians, overseers, collectors, chief officers of police, or members of school boards and their staffs. More than 300 officials are thus engaged in administering the affairs of one borough, which might be efficiently governed by one authority, comprising but a third or less than a third of this number. The infinite subdivisions and intermingling of areas may be an almost unavoidable consequence of the growth of our system of local self-government; but the fact remains that such a state of things tends to make local taxation intolerably burdensome, because of the inevitable waste and extravagance involved by so utterly needless and foolish a multiplicity of authorities.

The aggregate receipts of the various local authorities of England and Wales, excluding loans, and making the necessary deductions in order to avoid duplicate reckonings, amounted to no less than £43,849,181 for the last year for which returns have been published. The principal items of receipt are shown in the following table:—

Public rates,	£25,666,552
Treasury subventions and payments,	3,610,219
Tolls, dues, and duties,*	3,486,668
Receipts from real and funded property (excluding sales),	1,196,979
Sales of property,	668,599
Fines, penalties, fees, and licenses,†	1,015,532
Revenue from waterworks,	2,086,219
" " gasworks,	3,302,119
" " markets (excluding rents and tolls), cemeteries, and burial-grounds, sewage farms, baths and washhouses, tramways, fire brigades, slaughter-houses, lunatic asylums, & hospitals,	693,919
Repayments in respect of private improvement works,	766,318

The aggregate expenditure of the same authorities during the year, so far as it was not defrayed out of loans, and with the same deductions as before, amounted to £44,053,904. The principal items of expenditure are shown in the following table:—

Relief of the poor (including salaries),	£6,801,656
Pauper lunatics and lunatic asylums,	1,469,843
Police,	3,487,933
Education (including expenses of school boards, school attendance committees, reformatories, and industrial schools),	3,190,851
Highways, street improvements, and turnpike roads,	5,439,166
Gasworks,	2,429,148
Public lighting,	867,083
Waterworks,	792,624
Sewerage and sewage disposal,	916,671
Markets and fairs,	250,048
Cemeteries and burial grounds,	237,948
Fire brigades,	205,918
Public buildings (offices, &c., not included under other headings),	171,011
Parks, pleasure grounds, commons, and open spaces,	144,992
Libraries and museums,	140,199
Baths and washhouses,	117,126
Bridges and ferries,	193,144
Artisans' and labourers' dwellings improvement schemes,	105,989
Contagious Diseases (Animals) Act,	62,576
Hospitals provided by sanitary authorities,	112,828
Harbours, piers, and docks,	1,181,023
Land drainage, embankment, and river conservancy,	260,229
Tramways and other public works,	2,848,560

* Market rents and stallages are included under this heading, except in the case of the Corporation of London, whose market rents are included under receipts from real and funded property.

† Including £551,038 from school fees and sale of books, &c., to children.

Private improvement works, .	£512,515
Payments in respect of principal and interest of loans, .	9,878,531
Salaries (not included under other headings), ...	1,418,397
Establishment charges, . . .	389,872

For many years past loans have been contracted by Local Authorities of the National Debt Commissioners and the Public Works Loans Commissioners at a much greater rate than the annual repayments, and the burden upon the ratepayers is already seriously heavy. The amount borrowed in 1884–85 was £11,141,053, as compared with £7,928,753 during the preceding year. The outstanding loans of the Local Authorities at the end of the year 1884–85 amounted to £173,207,968, as compared with £164,847,463 at the end of the previous year. It may be mentioned in this connection that the rateable value of England and Wales for poor-rate purposes was £147,350,562 according to the valuation lists in force at Lady Day, 1885.

It should be borne in mind, with respect to the above loans, that some of them, *e.g.* a majority of those for harbours, piers, and docks, are not charged on the rates. Others, such as those incurred for water-works, gas-works, markets, &c., are primarily charged, in many cases, on the revenues of those undertakings. Some of the principal objects on which this vast outlay has been made are—

Schools, ...	£14,876,928
Highways, street improvements, &c.,	26,945,772
Water-works, ...	30,228,104
Sewerage and sewage disposal, .	16,569,353
Gas-works, ...	13,726,460
Harbours, piers, and docks, . .	28,537,809
Markets, ...	4,997,030
Artisans' and labourers' dwellings improvement schemes, . . .	3,532,383
Parks, pleasure grounds, commons, and open spaces, ...	2,411,108
Lunatic asylums, ...	3,326,396

The returns of local government finance in Ireland and Scotland are by no means so complete and ample as those of the English board. As near as can be ascertained, the annual local revenue from all sources in Ireland is £1,290,000, and that of Scotland £7,270,000. These figures include government contributions, averaging about £2,000,000 to Ireland, and £500,000 to Scotland. Ireland has exhibited peculiar aptitude for local government, and many financial reforms have been for years carried out there, which in the other parts of the United Kingdom still perplex the various local bodies; such, for instance, as the abolition of turnpike tolls, in 1857; the division of parochial rates on a definite scale between owner and occupier, in 1838. Poor-law administration has also been so successfully carried out in Ireland, as to reduce the expenditure under this head to a proportion far below that prevailing in other parts of the kingdom. The poor-law expenditure of Scotland is relatively in excess of that of Ireland, while the law of settlement, as carried out in the former country, acts with especial harshness on the poor.

The whole subject of local government has been gradually forcing itself to the front for some years, and a scheme for its thorough reorganization will no doubt shortly be brought before Parliament.

("History of Taxation and Taxes in England from the earliest Times to the present Day," S. Dowell, London, 1884; Guizot's "History of Representative Government;" "History of the English People," J. R. Green; "Local Government and Local Taxation in England and Wales," R. S. Wright and H. Hobhouse, London, 1884; "Principles of Political Economy," H. Sidgwick, 1883; "Political Economy," F. A. Walker, 1883.)

TAX'IDERMY is the art of preserving, preparing, and mounting the skins of animals for the purposes of the naturalist. The first operation in taxidermy is that of the removal of the skin in such a manner as to preserve its appearance, an operation which requires much care and dexterity, and this must be followed by its treatment with some preserving preparation. In the case of small animals the best preparation is arsenical soap, for the making of which there are several formulæ, the following being the most common: arsenic, 1 oz.; white soap, 1 oz.; carbonate of potash, 1 drachm; distilled water, 6 drachms; camphor, 2 drachms. The soap, cut in thin shavings, is dissolved in the water, which is gently heated, and then after it has been removed from the fire the other ingredients may be gently stirred in, the camphor being first pounded in a mortar with a little spirits of wine. This soap prevents the attacks of insects, and keeps the skin soft and free from decay. Larger skins are often treated with "preservation powder," made up of arsenic and burnt alum, each 1 lb.; ground oak bark, 2 lbs.; camphor, ½ lb. These substances are reduced to powder, thoroughly mixed, and then passed through a fine sieve. When used it must be thoroughly rubbed into the skin from the flesh side, and on account of its poisonous nature the hands require to be protected by gloves during the operation. Corrosive sublimate, carbolic acid, and more recently salicylic acid have been used in different ways in taxidermy with success, but their use requires so many details that directions cannot be given within the limits of this notice. In the stuffing and mounting it is usual to retain the skull and much of the skeleton, over and around which the stuffing material is placed, so as to form an accurate model of the creature to be represented.

TAXO'DIUM is a genus of plants belonging to the order CONIFERÆ, nearly allied to Cupressus (CYPRESS), from which it is distinguished chiefly by having the male catkins disposed in loose panicles, and the female catkins roundish and composed of peltate two-seeded scales, the seeds being without wings. The species are lofty trees, natives of the southern parts of North America. The Deciduous Cypress (*Taxodium distichum*) is a lofty deciduous tree, inhabiting swampy ground in Florida and on the Delaware and Mississippi. It grows to a height of from 100 to 150 feet, and is a handsome tree with slender branches and flat linear deciduous leaves arranged into two rows. It flowers in May, and the brown globose cones ripen in the spring of the following year. This tree was introduced into Europe from North America as early as 1640. The first plant that is mentioned as existing in this country was grown in South Lambeth, and was raised from seeds brought from Virginia. Since then it has been naturalized in various parts of Great Britain, and many fine specimens are now to be found. It does not attain an equal size in this country to that attained in its native soil, but it grows to a height of from 50 to 80 feet in a rich moist soil in sheltered situations. It is liable to sport exceedingly in cultivation, a number of trees growing together presenting great varieties of form and foliage (Loudon). In America its wood is used for all the purposes to which timber is applied. The roots of large trees are sometimes covered with large hollow excrescences which are used by the negroes for beehives.

TAX'US. See YEW.

TAY. See PERTHSHIRE.

TAYG'ETOS (Gr. *Taygetos*), a lofty range of mountains lying west of the town of Sparta, separating Laconia and Messenia, and deriving its name from Taügetê, the daughter of Atlas, and mother (by Zeus) of Lacedæmon (Lakedaimôn) and Eurôtas. The first of these gave the original name to the town later called Sparta, and the second to the river on which it stood. The mountain is memorable from the fact that to insure a hardy race of

citizens the Spartans were by law compelled to cast out naked upon the barren slopes of Taygetos any new-born child who seemed weakly or was deformed. If the poor thing had strength to live through such cruel usage and was found alive next day it was taken care of. Most, of course, perished.

TAYLOR, SIR HENRY, poet and dramatist, was born in 1805. He had published in 1827 "Isaac Comnenus," a historical drama or dramatic poem, when in 1834 he won the suffrage of a high class of readers and critics of poetry by his "Philip van Artevelde," a dramatic romance, the very length of which showed that it was meant for the closet, not for the stage. Blending a deep dramatic interest with a grave philosophy, and written in pure and nervous English, "Philip van Artevelde" at once took rank as a sterling work of poetic art. In 1836 appeared Taylor's best-known prose work, "The Statesman," a series of essays on the duties of high official life; aiming, to quote the author's words, at "directing the attention of thoughtful men from the forms of government to the business of governing." His poems, in a collective form, were published in 1863. He died 27th March, 1886.

TAYLOR, JEREMY, an illustrious English churchman, "the modern Chrysostom," was born of an ancient and respectable, but somewhat decayed family, at Cambridge, 15th August, 1613. In his fourteenth year he was entered at Caius College, Cambridge, as a sizar, becoming M.A. in 1633. Having taken orders, a lecture delivered in London attracted the notice of Laud, who had him settled at Oxford, and in 1636 nominated him to a fellowship of All Souls. In 1638 he was presented by Juxon, bishop of London, to the rectory of Uppingham, in Rutlandshire, a preferment which he retained until 1642, when his living was sequestrated by the Parliament. In the Civil War he was a stanch adherent of Charles I., who made him his chaplain, and for a defence of Episcopacy written at the king's request commanded his admission to the degree of D.D. in 1642. Taylor preached several times before the court at Oxford, and occasionally followed the army as chaplain; but in 1645 he was obliged to retire into Wales, where he lived under the protection of Richard Vaughan, earl of Carberry, at Golden Grove. During this period of retirement, which lasted thirteen years, Taylor maintained himself by teaching school, and composed some of his most important works. He was at times reduced to very straitened circumstances, and he also suffered several short imprisonments on account of his royalist sympathies. In 1660, after the Restoration, Charles II. nominated him Bishop of Down and Connor, to which the bishopric of Dromore was added in 1661, and he was also elected Vice-chancellor of the University of Dublin the same year. In his new station he laboured most industriously in the defence of Protestantism and Episcopalianism, but his episcopate was brief, for he was attacked by fever 3rd August, 1667, at Lisburn, where he died 13th August after an illness of ten days.

Taylor's writings may be brought under four descriptions—viz. practical, theological, casuistic, and devotional. The first comprises a "Life of Christ" (1649), which is marked by opulence of illustration, originality of thought, solemnity of tone, and tenderness of appeal "Holy Living" (1650), and "Holy Dying" (1651), tw tractates of experimental godliness, fervent in spirit and noble in aspiration; and "Sermons" (1650-53). To tl second division belong his "Episcopacy Asserted" (1642); "The Liberty of Prophesying" (that is, of interpretation), a grand discourse on behalf of toleration and mutual charity among all Christian sects; his "Unum Necessarium, or the Doctrine and Practice of Repentance" (1655), a treati which was condemned by many of his brethren as being Pelagian in doctrine; and his "Dissuasion from Popery" (1647). His principal casuistic work is the celebrated "Ductor Dubitantium" (1660), which is justly considered the most learned work on casuistry which has appeared in the English language. Amid much that is doubtful the book abounds in the sharpest subtleties, the finest distinctions, and the quaintest reasonings upon different points in Christian ethics. Of his devotional works perhaps the best known is his "Guide of Infant Devotion, or the Golden Grove" (1655), the latter name being given in memory of the mansion of his protector and patron, the Earl of Carberry. The genius of Jeremy Taylor has been universally recognized, and in his works this, together with his earnest piety, is everywhere manifest. His imagination was a predominant faculty, so that his pages teem with illustrations, and are replete with lofty sentiments and gorgeous prose-poetry. It is this quality that has led Emerson to refer to him as

> "The younger golden lips or mines,
> Taylor, the Shakespeare of divines;"

while concerning his whole character it was well observed by Bishop Rust, "he had devotion enough for a cloister, learning enough for a university, and wit enough for a college of virtuosi." The most complete edition of his works is that by the Rev. C. P. Eden, M.A. (ten vols., London, 1854).

TAYLOR, JOHN, self-styled "The Water-poet," was born in 1580, at Gloucester, and, according to Wood, went to school there. In his education, according to his own account, he got no further than his accidence. At an early age he was bound apprentice to a London waterman. According to a passage in his "Pennyless Pilgrimage," he was, when sixteen, at the taking of Cadiz in 1596, and afterwards at the Azores "in the Rambowe of the Queene's." On his return he plied his sculls on the Thames as a waterman. "At home," says Chalmers *sub voce* (*Biographical Dictionary*), "he was many years collector for the lieutenant of the Tower, of the wines which were his fee from all ships which brought them up the Thames, but was at last discharged because he could not purchase the place at more than it was worth." He must have been well known before 1618, when he published his "Pennyless Pilgrimage"—a description of a journey which he performed in that year from London to Edinburgh, and as far north as Elgin, "not carrying any money to and fro, neither begging nor asking for meat, drink, or lodgings." He was hospitably entertained at the seats of noblemen and gentlemen, and his work contains several curious traits of Scotland and the Scotch. On his return journey, he mentions, he received a gratuity at Leith from his "friend Mr. Benjamin Jonson," then also visiting North Britain. In 1630 he had published enough to issue a collected edition of his works. On the breaking out of the "great rebellion," Taylor, who was a fervid royalist, went to Oxford, where he opened a tavern and wrote "pasquils" against the Roundheads, which Wood opines were of service to the royal cause. A curious tract, like many of his writings half prose half doggerel, which he printed but did not dare to publish, describing a loyal pilgrimage which he made in 1648 to Newport in the Isle of Wight, when Charles was imprisoned there, has been reprinted by Mr. Halliwell in "Literature of the Sixteenth and Seventeenth Centuries" —"Taylor's Travels from London to the Isle of Wight." Meanwhile he had returned to London, and there he opened a public house, over which, on the death of the king, he suspended, as long as he dared, the sign of the mourning crown. One of the earliest of his many publications was his "Journey into Wales," published in 1652, at which time he kept the "Poet's Head" in Phœnix Alley, Long Acre. He died in 1654. In the "Censura Literaria" there is a list of Taylor's numerous pieces, the chief value of which lies in their interesting illustrations of the aspects, manners, &c., of the Britain of his day.

TAYLOR, PHILIP MEADOWS, C.S.I., was born in Liverpool[*], in 1808. In 1824 he went to Bombay, and obtained a commission in the service of the Nizam, rising to the command of a regiment. His industry, ability, and learning soon marked him out as eminently qualified for civil administration, and he was accordingly transferred to the civil service of that prince. Here his services were of the highest value, especially in the suppression of "Thuggee," and in the political charge of Berar during the Indian mutinies. During his long residence in India, Colonel Taylor acquired a profound knowledge of the languages of Southern India, and an intimate acquaintance with the manners, customs, and religion of the people. Returning to England on leave, he published the well-known remarkable work, "The Confessions of a Thug," which attracted great notice. Going back to India, he was appointed in 1850 administrator of Shorapore during the minority of the rajah, which he raised to a high degree of prosperity. He was subsequently appointed deputy commissioner of the western ceded districts. On his retirement from actual service he was made Companion of the Star of India in 1869, and received a pension. He now devoted himself to literature, contributing to various periodicals, and producing a series of tales of extraordinary ability and interest, illustrative of Indian history, society, and character—"Tara," "Ralph Darnell," "Seetah," and "Tipu Sultan." He also wrote an admirable compendium of Indian history, decidedly the best abridgment on the subject that has yet appeared. He again went to India, and on his way home died at Mentone, on the 13th of May, 1876.

TAYLOR, ROWLAND, the English martyr, was chaplain to Archbishop Cranmer, by whom he was appointed to the rectory of Hadleigh in Suffolk. He refused to perform mass in his church at Hadleigh, and was summoned before Gardiner, bishop of Winchester, who was then lord-chancellor. He might have escaped if he had chosen to evade the summons, but he preferred to undergo the ordeal of a trial, where he resolutely and ably defended himself, both on the charge of non-performance of mass, and that he, a priest, had contracted marriage. On the 5th of February, 1555, after much endurance in prison, &c., he was conducted to Oldham Common, near Hadleigh, by the sheriff and other officials, who tried to persuade him to recant, but unavailingly. He was burnt amidst the prayers and blessings of his parishioners, who set up a stone on the place of execution to mark where "Dr. Taylor, in defending that was gode, at this plas left his blode."

TAYLOR, TOM, known chiefly as a dramatic writer, was born at Sunderland in 1817. He was educated there, at Glasgow University, and at Trinity College, Cambridge, of which he became a fellow. Entering himself at the Inner Temple, he was called to the bar in 1815, and went the northern circuit. Meanwhile he had commenced his long connection with *Punch*, some of his most striking contributions to which were in the department of serious poetry. In 1850 he was appointed assistant-secretary to the board of health, of which he became secretary in 1854. He was the author or adapter, singly or in conjunction with Mr. Charles Reade, of a number of popular dramas; the compiler of the "Life of Benjamin Robert Haydon, the painter" (1853), from his autobiography and journals; and the editor of the "Autobiographical Recollections of C. R. Leslie" (1868). He died 12th July, 1880.

TAYLOR, ZACHARY, twelfth President of the United States, son of Colonel Richard Taylor, was born in Virginia, 24th November, 1784. His early life was spent in rural pursuits, till in 1808 he received a commission as lieutenant in the army. He served first against the Indians, and afterwards commanded in the Mexican War. His victory over the Mexicans at Buena Vista, with only 5500 men against an army of 21,000, commanded by President Santa Anna, created great enthusiasm, and "Old Rough-and-Ready," as he was called in the army, was nominated in 1848 for President of the United States, and though opposed by General Cass, Martin Van Buren, and C. F. Adams, he was triumphantly elected, and entered upon the presidency in 1850. He only occupied the post four months, and died on the 9th of July in that year.

TAYLOR'S THEOREM. This important theorem was first published by Brook Taylor in his "Methodum Incrementorum" (London, 1715). It supplies, in all possible cases, the development of a function, $F(x+h)$, in ascending or incremental powers of h. Proofs of it will be found in all standard treatises on the calculus, and have engaged the attention of Lagrange, Ampère, Maclaurin, D'Alembert, and others. We have no room for these particulars, but confine ourselves to a simple statement of the theorem itself.

Denoting by $F^{(i)}(x)$ the i^{th} derived function of $F(x)$, we have—

$$F(x+h)=F(x)+\frac{h}{1}F'(x)+\frac{h^2}{1.2}F''(x)+\ .\ .\ .$$

$$+\frac{h^i}{1.2\ \ldots\ i}F^{(i)}(x)+R^i,$$

which is true if neither $F(x)$ nor any of its derived functions become infinite for values of x between which the theorem is used. We may express the *remainder*, *limit*, or *residue* R^i, which must be added to complete the formula, in the following manner:—

$$R=\frac{h^{i+1}}{1.2\ .\ .\ .\ (i+1)}F^{(i+1)}(x+\theta h).$$

If we employ a definite integral, the remainder may be thus expressed:—

$$R^i=\frac{1}{1.2\ .\ .\ .\ i}\int_0^h z^{i}F^{(i+1)}(x+h-z)\,dz.$$

When $F(x)$ is a rational and integral function of the n^{th} degree, R^i will be 0, and the series will terminate with the $(n+i^{th})$ term. Or $F(x+h)$ may be rendered by the corresponding infinite series, provided the same be convergent, if it can be shown that R^i vanishes when i is augmented without limit. The converse, however, is not necessarily true; for though the infinite series be convergent, it may not express the value of $F(x+h)$, since R^i may not vanish. This illustrates the need of taking the remainder R^i into consideration. In such case Taylor's theorem is said to "fail."

TAZ'ZA, a kind of bowl or cup often used for decorative purposes by the ancients, very shallow, and with a foot and base, ornamented also with handles. It is from this word that the French *tasse* (cup) is derived.

TCHAD or **TSAD,** a large fresh-water lake in Central Africa, region of Soudan, between lat. 12° 30′ and 14° 20′ N., lon. 13° and 15° 10′ E. It occupies the lowest part of a broad hollow in the centre of the continent, its elevation being variously estimated by different travellers at from 800 to 1150 feet above the sea. Shaped like an irregular triangle, the base of the Tchad, invaded by the delta of the Shari River, extends about 110 miles east to west. In the dry season the lake has an area of about 10,000 square miles, but after the rains it spreads out over its low shores to cover an area several times as large. In the dry season, before the rain begins in June, it presents the appearance of an immense swamp, overgrown along the borders with reeds and papyri – the haunt of hippopotami, which may be seen in herds of a hundred at a time; waterfowl are also in extraordinary numbers. The marshes begin to fill up in August, and the highest stage of the lake is reached in the end of November, when its level is 20 to 30 feet above that of the lowest period.

An archipelago of islets fills all the north-eastern portion of the Tchad; these become connected together in the dry season with the mainland. They are inhabited by the Yedina or Budduma, a negro tribe of notorious pirates, who navigate the lake in flat-bottomed vessels. Dr. Nachtigal, who visited this region in 1875, placed it beyond doubt that the Tchad occasionally overflows to north-eastward by a broad channel, named the Bahr-el-Ghazal, which leaves the lake-shore at the south-eastern corner, and running north-east for a distance of 300 miles, opens out into a second depression called the Plain of Bodele. Immense quantities of fish are obtained in the lake, and of natron from the shores of its islands. The chief tributaries of the Tchad are the Shari from the south, the Yeou from the west, and several streams from the south borders of the Sahara. The Shari flows 200 or 300 miles through level plains. In lat. 10°, more than 100 miles south of the lake, Dr. Vogel found this river at the beginning of the wet season 2000 feet wide, and 15 feet deep generally, but with sandbanks in some parts having only 6 to 8 feet of water; its velocity was four miles an hour. In the rainy season it is 30 feet deep, and discharges 140,000 cubic feet of water per second into the lake. The whole region is subject to the Sultan of Bornu.

TCHE or **TSANG** is the Chinese equivalent to our zither, usually made of wood ornamented with bone, and bearing sixteen thin wire strings. It is tuned by movable bridges like a sonometer. The *Tché* (accented) is quite another instrument; it is a sort of flute, made of bamboo.

The *Tchen* is yet another completely different instrument; it is a metal plectrum which is struck or rattled vigorously along the *ou* or serrated saw-like metal back of a framework, usually in the form of an animal, as for example, a tiger.

TCHERNAY'A, the name of a village and small river on the south-east of Sebastopol, where a sanguinary battle was fought between the Anglo-French and Russian forces on the 16th of August, 1855. The attack commenced on the part of the Russians, who suddenly crossed the river at several points; but they were driven back with great slaughter to their former position. The loss of the Russians on this occasion was estimated at upwards of 5000 killed and wounded.

TCHERNIGOV', a town of Russia, the capital of a government of the same name, is situated on the Desma, 80 miles N.N.E. of Kiev. It is the see of an archbishop, and has a cathedral, built in 1024, and a strong citadel. The population is about 20,000.

TCHET'VERTAK, the Russian franc, is actually worth not 100, but 99 centimes. It is a silver coin, and contains 25 kopecks, say 9½*d.* English.

TCHOU, a Chinese wooden instrument of percussion, made from a light wood very similar to our pine. It is practically a box, in which a wooden hammer is suspended; and the hammer is made to beat the box by the hand, passed through a hole in the side of the box made for that purpose. The performance has certainly the merit of simplicity, and is probably, as the Chinese say it is, of untold antiquity. It is quite certain that all instrumental music began with some variety of drum, in every country alike.

TE DEUM, the first two words of the well-known Latin hymn, "Te Deum Laudamus" (We praise Thee, O God). Though its authorship has been generally attributed to St. Ambrose, and St. Hilary and St. Augustine have also been credited with this fine hymn, it is now generally believed to have been composed in the Gallican Church some time prior to the fifth century. In the morning service of the English Church it is sung or read after the first lesson. It has been set to music by almost all the great composers. One celebrated musical version is known as the "Dettingen," because composed by Handel on the occasion of the public thanksgiving for George II.'s victory at Dettingen.

TE IG'ITUR. In early chronicles one sometimes meets with oaths sworn upon the *Te Igitur* as indicating a particularly solemn and binding covenant; and also in the ordeal by compurgation the *Te Igitur* was used rather than the Gospels. This book is one of the service books of the Roman Catholic Church, and derives its name from the opening words of the canon, "Te igitur clementissime Pater." It is reserved to the use of bishops and other dignitaries.

TEA (Thea), from the Chinese *tcha* or *tha*, is a genus of shrubs of the order TERNSTRŒMIACEÆ, closely allied to the genus CAMELLIA, in which it is included by Bentham and Hooker. The characters of the genus or subgenus are as follows:—The calyx consists of five persistent sepals with bracts at the base; the petals are usually five, sometimes seven or eight; the stamens are numerous, a portion forming by their united bases a cup within which are five, seven, or eight free stamens; the styles are three; the fruit or pod is usually three-celled, with a single large seed in each cell, and splits at maturity through the cells into three valves, each of which has a partition down its middle. The only important species is the Tea plant *(Thea sinensis)*, the dried leaves of which form the tea of commerce, and yield a peculiarly wholesome and extensively used beverage. The tea plant in the wild state is a bushy shrub, and sometimes a small tree, growing to a height of from 20 to 30 feet; but in cultivation it is kept dwarf by pruning, so that it does not exceed a height of 5 or 6 feet. It has shining leathery, lanceolate, serrate, evergreen leaves, from 2 to 6 inches long, and white fragrant flowers, growing either singly or two or three together in the axils of the leaves. [See Plate.] It chiefly grows in China, where its cultivation spreads over a wide district between the 23rd and 35th degrees of north latitude; but it also grows in Japan, at least ten degrees further north; in the Eastern Himalayas, and particularly in Assam, where it attains a superior degree of excellence. Whether it is truly indigenous to all these countries is uncertain. It has been cultivated in China from a very early epoch; the cultivation in India is probably not so ancient, as there is no Sanskrit name for the plant. It appears to be truly wild in Upper Assam, and probably also in the mountainous districts of South-west China. A hardy evergreen shrub, the tea plant might be cultivated in almost any district up to the 40th degree of north latitude. In Java, Ceylon, and Brazil, as well as in the southern states of the Union in North America, it has been cultivated successfully. In the vicinity of London it has borne a severe winter without protection; but it must be owned that it nowhere flourishes so abundantly or so vigorously as in its Asiatic habitat.

The varieties of tea are very numerous, owing to the care which for centuries has been bestowed upon its cultivation. Their Chinese names are derived from their appearance or place of culture. Thus, *Pekoe* is from *pecco*, "white hairs," because the very young leaves from which this tea is made bear a white down upon them. *Bohea* is derived from the *Bu-i* Hills, where the plant grows. *Hyson*, from *yu tsien*, "before the rains," or *hichun*, "flourishing spring," because the leaves are gathered early in the year. *Souchong*, from *sian chung*, means "little plant."

The two kinds of tea so well known in Europe as black and green, were originally supposed to be the outgrowth of different species, but are now understood to be merely varieties of the same plant, owing their colours to the mode in which the leaves are prepared. The leaves when gathered are exposed in shallow baskets to the sun and air, which withers and slightly dries them, and prevents fermentation. They are then thrown in small quantities

into round flat copper or iron pans, and exposed to a gentle fire-heat for about five minutes, during which time they are rapidly stirred; this renders them soft and pliant, and causes them to give off a large quantity of moisture. Next they are emptied out into vessels or on to a table and well rolled between the hands into the shape which they finally retain. Exposure to the air, with a final heating till the leaves are completely dried, complete the process for some teas, while for others these last two processes are alternated several times. For *green* teas the process of drying is completed as soon as possible after picking, and the temperature in the final drying is not so high; *black* teas are exposed for a greater length of time to the air in order that a slight fermentation may take place. The greater part, however, of the green teas exported to Europe and America is coloured artificially. The principal materials used in colouring are China clay or terra alba, Prussian blue, turmeric, gypsum, and indigo; the colouring matters, mixed in proportions to produce the desired shade, are added to the slightly moistened leaves, which are stirred until the colour becomes evenly distributed. Black tea is also adulterated to improve its appearance by being faced with plumbago or blacklead, added in fine powder to the tea in a revolving cylinder, where the leaves, by being rubbed together, acquire a peculiarly smooth and glossy appearance. Different kinds of teas are also scented by the admixture of fragrant flowers, chiefly those of the sweet-scented olive (*Olea fragrans*), and the Chulan (*Chloranthus inconspicuus*). The different kinds of tea, as met with in commerce, depend chiefly on the size and age at which the leaf is picked.

The leading varieties of both green and black imported into Great Britain are as follows:—

Green.—1. Gunpowder sorts: Pin's-head or Pingsacy, Moyune, Imperial Moyune, Canton, and Shanghai. 2. Hyson sorts: Moyune, Moyune young, Canton young, Twankay or Imperial Hyson, Shanghai, and Shanghai young. (The above varieties are all Chinese.) 3. Japanese: Gunpowder and young Hyson. 4. Javanese: Gunpowder.

Black.—1. Congou sorts: Hung-muey, Kaisow, Gonam, Gopack, Canton, and Foo-chow-foo. 2. Pekoe sorts: Foo-chow, Flowery Pekoe, Oolong, Souchong, Plain Orange, Scented Orange, and Canton Scented Orange. (The above varieties are all Chinese.) 3. Assam: Congou, Souchong, and Orange Pekoe. 4. Javanese: Congou and Imperial.

The Gunpowder in green and the Pekoe in black constitute the finest qualities, consisting of the youngest leaves of the first picking; Flowery Pekoe consists of these leaves so young that they are still covered with down. Bohea is the coarsest kind of tea, and is now seldom exported. Th finest kinds of tea will not bear a sea voyage, and are consumed by the wealthy Chinese or exported overland t Russia, where they fetch a very high price.

The principal tea plantations are situated in the nortl of China. They are usually of small size, and the soil requires to be carefully kept and richly manured. The plants are raised from seeds sown in the places where they are to remain. The holes are 4 or 5 inches deep, and about 3 to 4 feet apart. As the young plants grow, they are kept free from weeds, and when three years old they yield their first crop of leaves. They are seldom transplanted; but in order to form a fine bush, four or six plants will be set close together. After they have grown six or seven years they are cut down, that the numerous shoots which then spring forth may supply an ampler crop of leaves.

The most successful tea plantations are those situated on low, undulating slopes. To insure a constant and rapid succession of leaves, both heat and moisture are indispensable; but the latter must be derived from running streams, and not from stagnant pools. Above all things it is necessary that the gardens should be above all danger of inundation, for water lodging about the roots turns the leave yellow, and generally weakens the plant. Recently great attention has been paid to the subject of manure, now that the soil is no longer enriched by the decaying vegetation of the primeval forests. Trees, indeed, are still left here and there, for the twofold purpose of shading the seedlings and of retaining moisture in the soil; but the mature plant requires sunshine for the healthy development of its leaves. In the early days of the industry planters were content with three gatherings in the year, of which the first and best took place in April, when the young leaf-buds were still covered with a whitish down. The second harvest, so to speak, came off in June, when the leaves were of a dull green hue, and less delicate in flavour; and the third in July, when the leaves were dark green, and altogether coarser. Experience, however, has shown that the tea-plant can put forth eight or nine "flushes" of leaves in the course of the year without being sensibly injured; nor is there any very appreciable difference in the quality of the various pluckings.

In Assam black and green teas are made from the same plant, though the best green implies superior culture, and is also differently prepared. The Chinese seldom allow the shrub to exceed 3 feet in height, so that it is continually putting forth fresh branches, while the gatherers can squat on the ground and be aided by their children. In India, however, the plant is commonly suffered to grow as high as 6 and even 8 feet. Seedlings will yield a small crop in the third year, but the plant does not attain maturity before the sixth, and will bear for at least forty years if properly managed. The most genial soil is a light porous yellow loam, belonging to the clay-slate formation, fertilized by decaying matter or cattle manure. Since the great extension of tea cultivation, dating from 1866, either indigenous or hybrid seed has been almost exclusively used, though previously the preference seems to have been given to China seed. The tea made from these varieties is rough, pungent, and brisk, with a rich malty flavour; while that from the China plant is much milder in all respects. In Assam these qualities are obtained in the highest degree; in Cachar they are slightly modified; and in Darjeeling, especially on the higher ranges, the pungency and rich malty flavour are somewhat wanting, though compensation may be found in superior aroma and delicacy. The nearer the Indian teas approach the corresponding China varieties, the lower is their market value, while the most esteemed are the kinds which possess in the highest degree the essential attributes of the Assam type. The strong, pungent Assam leaf is at present chiefly employed for mixing with China teas of low quality to revivify and impart flavour to them, which of itself is the best proof of their richness in the essential principle of theine and aromatic oil. Originally, it was found necessary to employ Chinese labourers largely, at every stage from plucking to the packing of the tea, and they are still valued as superintendents and in the nicer operations, where their delicacy of touch is unrivalled. Machinery, however, has now been very generally introduced for rolling and sorting, and will, of course, almost entirely supplant hand labour wherever possible, as it becomes more perfected.

The name "tea" is also applied to various plants which either contain theine, the same stimulating principle, or resemble the true tea in flavour or smell. To the former kind belong Maté or Paraguay tea of South America, and the Kolanut of Western Africa; to the latter, Abyssinian or Arabian tea, distilled from *Catha edulis*; Australian or New Zealand tea, from species of Leptospermum and Melaleuca; Bourbon tea, from *Angræcum fragrans*; Labrador tea, from *Ledum latifolium*; South Sea tea, from *Ilex vomitoria*; and Theezan tea, from *Sagaretia theezans*.

It has been said that nearly half the human race drink tea of some sort or another, and there are many plants

which contain the stimulating property of the Chinese and Indian tea of commerce. Of these the more important are *maté*, guarana, cola nut, and the leaves of the coffee plant, but colonists and early settlers in America and the British colonies used many other plants which formed more or less efficient substitutes, to which the name of tea was given. Thus the *Ceanothus americanus* is known as New Jersey tea, the *Capraria biflora* as West Indian tea, the *Leptospermum scoparium* as New Zealand tea, &c. While, however, we find the use of tea thus widely diffused throughout the world, it is somewhat remarkable that there is no general agreement as to the best method of preparing it for use. In China the tea is put into the cup, boiling water is poured upon it, the cup is covered by the saucer, and the beverage is afterwards drunk off the leaves without any addition. In Japan teapots are used, and the leaves are triturated before putting them into the pot. In Russia the tea is made in a rather weak infusion, which is flavoured with slices of lemon and drunk very hot. In Morocco green tea is put into a pot, with a little tansy and a great deal of sugar, and the pot is then filled with boiling water. In Bokhara every man carries a small bag of tea about with him, a certain quantity of which he hands over to the booth-keeper he patronizes, who concocts the beverage for him. The average Bokhariot finds it as difficult to pass a tea booth as our own habitual drunkard does to go by a public-house. His breakfast beverage is called Schitschaj, and consists of tea flavoured with milk, cream, or mutton fat, and in which his bread is soaked. During the daytime sugarless green tea is drunk, with the accompaniment of cakes of flour and mutton suet. In drinking tea it is considered an inexcusable breach of manners to cool the hot beverage with the breath, but the difficulty is overcome by supporting the right elbow in the left hand and giving a circular movement to the cup. The time each kind of tea takes to draw is calculated to the second, and after the infusion is imbibed the can is passed round for each tea-drinker to take a pinch of the leaves, which are eaten as a dainty. A modern traveller in Asiatic Russia, who had to claim the hospitality of the Buratsky Arabs, gives an amusing account of the way tea was prepared:—The mistress of the tent, placing a large kettle on the fire, wiped it carefully with a horse's tail, filled it with water, and threw in some coarse tea with a little salt. When this was near boiling point she stirred it with a ladle until the liquor became brown, and then it was poured off into another vessel. Cleansing the kettle as before, the woman fried in it a paste of meal and fresh butter. Upon this the tea and some thick cream were poured, the ladle was brought into use, and after a time the whole taken off the fire and set aside to cool. The tea-soup thus made was afterwards served out in wooden mugs, and it served at once to satisfy both hunger and thirst. In the Western world tea is usually made by putting the leaves into a teapot, pouring boiling water over them, and afterwards flavouring the infusion with sugar and milk. When the beverage is required in large quantities urns are used, or if quality is not cared for the tea is boiled for a short time, together with allotted quantities of sugar and milk. With respect to the best method of making tea it may be observed that the teapot should be warmed by pouring boiling water into it before it is used for the tea-making. The water used should be quite fresh, and *the instant that it boils* it should be poured over the tea placed in the warm teapot, in the quantity required for consumption. Water that has been boiled for any length of time will not make a good infusion, a fact which receives special attention from professional tea-tasters. After the water has been poured over the leaves it should be allowed to stand for about eight minutes, and the tea is then ready for use. If it is necessary for the infusion to be kept for a longer time it should be *poured off the leaves*, or else the tannin which they contain will be taken up and the liquor will become bitter, astringent, and unwholesome. Tea made by boiling, or which is allowed to stand long on the leaves, is very apt to cause indigestion, from the tannin it contains.

With regard to the dietetical value of tea it must be admitted that the amount of nutrient matter in the infusion is almost nil, but it possesses great refreshing powers, and it is a powerful stimulant to the nervous system. It is not suited to young children, and persons of weak digestion are often unable to use it on account of the flatulence to which it gives rise. Taken in moderate quantity tea seems to cause an exaltation of the intellectual faculties, and to exercise a restorative action on the nervous system, the latter effect being aided by the warmth of the infusion. Strong tea, cold and unsweetened, is a very thirst-quenching beverage, and as it does not affect the head it is often adopted by mountaineers, pedestrians, and other persons who have actively to exert their muscles. An illustrious modern commander of the British army makes it a rule when upon active service to substitute double rations of tea in the place of ardent spirits, and though the step can hardly be described as popular with the men, there can be no question as to its efficacy in promoting health and endurance. On the other hand it must be admitted that when used in excess tea is seriously hurtful to the digestive functions, and that it also causes great loss of nerve power. It is not an uncommon practice with ardent students and hard-worked literary men to resist the claims of nature for repose, and to keep themselves up to the mark by the lavish use of tea. That it answers the purpose at the time cannot be denied, but the object is often attained at a fearful price, the destruction of health and vigour both of mind and body being the penalty. Sleeplessness, trembling of the hands, irritability of temper, and wanderings of thought are among the signs which signify that the system is saturated with theine, and where these or any of them become manifest, the use of tea should be given up and weak cocoa adopted as a substitute. Some effort of the will may be required for the change, for there is no doubt that the habit of resorting to tea or coffee for stimulation is one which grows, and which may be almost as hard to break through as that of over-indulgence in alcohol.

The medical uses of tea are not many. Weak cold tea is an excellent diluent in some forms of fever, and a stronger infusion, from its astringent properties, may be useful as a gargle or a lotion for inflamed eyes.

Tea Trade.—Tea, which has been used for ages in China, was utterly unknown to ancient and mediæval Europe, and it was not until after 1650 that it became an article of commerce. Previous to this it had only been received in small parcels, as presents from India, where it had been received from China; but in 1657 a London merchant, named Garway or Garraway, opened a house for the sale of tea as a beverage. In 1664 the East India Company presented a couple of pounds to the king, and in 1669 they received their first regular importation, in a commercial point of view, from their factory at Bantam. In 1678 there was an importation of 4713 lbs., but this was exceptional, for in the six following years the entire quantity amounted to no more than 410 lbs. The consumption after this, however, rapidly increased, for according to Milburn ("Oriental Commerce") the consumption in 1711 was 141,995 lbs., in 1715 it was 120,695 lbs., and in 1720 it reached 237,904 lbs. In 1745 the quantity was 730,729 lbs. Some time before the latter year the duty first levied had been changed into one of 4*s.* per lb. excise duty, together with a customs duty of 14 per cent. *ad valorem;* and the average annual revenue derived from 1740 to 1745 was £175,222 a year. But although the taste for tea was not much diffused, it was known that, in consequence of these high duties, large quantities were

clandestinely imported, and that the real consumption was much greater than the apparent one. To check this illegitimate traffic, which, as in all such cases, enriched the smuggler at the expense of the revenue and the fair trader, the duty was reduced to 1*s.* per lb. for the excise, and raised to 25 per cent. *ad valorem* for the customs, making the total reduction equal to nearly 50 per cent. To prove the wisdom of this step the quantity entered for consumption was at once considerably more than doubled, and in five years more than trebled. The amount of duty also increased from £175,222 for the annual average of the five years ending 1745, to £318,080 for the quinquennial period ending 1750. The duties were, however, again increased in 1759, and from that period to 1784 varied from 65 to 120 per cent. *ad valorem.* The revenue, however, did not increase in anything like a corresponding proportion, and smuggling was revived to an enormous extent. In 1784 the duties were reduced from 119 to 12½ per cent. *ad valorem*, and as a natural consequence the legitimate trade again immediately increased; for whereas the quantity sold in 1783 only amounted to 5,857,883 lbs., in the following year, when the duty was reduced, it increased to 10,148,257 lbs., and was nearly trebled in the course of two years, the quantity in 1785 being 16,307,433 lbs. The average annual amount of duty received during the five years preceding the reduction was £700,000, and in the five years succeeding it only fell to £340,000, to the agreeable surprise of the ministers of the day, who had only calculated upon about a fourth of that sum. Table I. below gives the most important particulars relating to the

TABLE I.

GREAT BRITAIN.

Year.	Quantities retained for Home Consumption.	Net am'nt of Duty.	Rates of Duty.
	Lbs.		
1790	14,693,299	£547,230	12½ p. cent. *ad ralorem.*
1795	18,394,232	695,108	20 " "
1800	20,358,702	1,152,262	40 " above 2*s.* 6*d.* p. lb. 20 " under " "
1805	21,025,380	2,925,298	95 " above " " 65 " under " "
1810	19,093,244	3,212,430	96 " on all teas.
1815	22,378,345	3,526,590	" "
1820	22,452,050	3,128,449	96 " below 2*s.* per lb. 100 " above "
1825	24,830,015	3,527,944	" "
1830	34,047,079*	3,387,097	" "
1832	31,548,409	3,509,834	" "
1833	31,829,620	3,444,102	" "

IRELAND.

Year.	Quantity charged with Duty for Home C'nsump'n	Net amount of Duty.	Rates of Duty. Black.	Rates of Duty. Green.
	Lbs.			
1790	1,736,796	£33,132	4*d.* per lb.	6*d.* per lb.
1795	2,970,701	64,093	4¼*d.* "	6½*d.* "
1800	2,926,166	69,824	5½*d.* "	7*d.* "
			ALL KINDS.	
1805	3,267,712	411,225	£84 14*s.* per cent. above 2*s.* 6d. per lb. £51 14*s.* p.c. under 2*s.* 6d.	
1810	2,922,568	435,307	93 per cent. on all teas.	
1815	3,462,776	531,400	96 per cent., the same as in Great Britain.	
1820	3,150,344	398,742	Same as in Gt. Britain.	
1825	3,889,658	503,074		

* This table includes all tea shipped to Ireland for consumption subsequently to the year 1827.

tea trade from 1790 to 1833, which was the year preceding the termination of the East India Company's monopoly. Up to that time they had had the trade exclusively in their own hands, although they were bound to provide ships to import the same, and always to have a year's consumption in their warehouses. The teas could only be imported into London, where they were disposed of at quarterly sales.

TABLE II.

	Quantities entered for Home Consumption.	Amount of duty received.	Rates of Duty.
	Lbs.		
1834	34,969,651	£3,589,361	From 1*s.* 6*d.* to 3*s.* p. lb. according to quality.
1839	35,127,287	3,658,803	2*s.* 1*d.* p. lb. on all kinds.
1844	41,363,770	4,524,193	5 per cent. additional.
1849	50,021,576	5,471,422	" "
1854	61,953,041	4,780,149	1*s.* 6*d.* per lb.
1859	76,362,008	5,408,924	1*s.* 5*d.* "
1864	88,637,099	4,481,868	1*s.* "
1869	111,796,491	2,795,162	6*d.* "
1874	137,422,216	3,485,586	
1879	160,652,528	4,016,318	
1884	175,097,983	4,877,449	
1886	178,894,151	4,472,353	

Table II. shows the rapid development of the tea trade since it was thrown entirely open in 1834, and especially the wonderful increase since the most recent reductions of the duty. From this it appears that in the two years after the impost had been lowered to 1*s.* per lb., the quantity entered for home consumption was increased by 10,000,000 lbs. per annum, and the change was even more marked when the duty was reduced to 6*d.* per lb., for between 1864 and 1879 the quantity used in the United Kingdom rose from 88,637,000 lbs. to 160,652,000 lbs. Thus in the course of the last twenty years the consumption has more than doubled, and every person in the United Kingdom now uses about 3¼ lbs. a year more than in 1841, and nearly 2½ lbs. more than in 1856.

The total and average consumption of tea by each individual in the United Kingdom in 1841, 1856, 1879, and 1886 were as follows:—

Year.	Total Consumption.	Average Consumption for each Individual. Lbs.	Oz
	Lbs.		
1841,	36,675,668	1	6
1856,	63,278,212	2	4
1879,	160,652,528	4	10
1886,	178,894,151	4	15

In addition to the large quantity consumed at home England is now the greatest tea depot in the world. The total quantity imported in 1886 was 230,895,292 lbs., and the exports 44,413,052 lbs.

Retailers of tea in the United Kingdom were formerly obliged to take out a license for its sale, which varied according to the rental of the house in which they lived,

but this was entirely abolished in 1869, and the trade is now quite free.

The investigations of a committee of the House of Commons in 1874 showed that a very large amount of tea arrived in England already adulterated; and in 1876, under the provisions of the Sale of Food and Drugs Act, customs officers were specially assigned to the duty of examining tea brought into London. These officers carefully inspect all tea on importation; and suspected parcels undergo a very searching analysis, after which, if found to be adulterated, the tea is condemned and destroyed. Since the passing of this Act the importation of bad tea and "lie" tea has very sensibly diminished, as also malpractices after tea has left the bonded warehouses. The importation of green teas—the class most subject to "facing" and other adulterations in a way injurious to health—has very much decreased of late years.

Compressed tea—the leaves having been consolidated by pressure—has been recently introduced into this country; but the efforts to promote its use among the general public have hitherto been attended with only partial success, although for many purposes it has, of course, great advantages. It was served out to the troops during the Ashantee campaign in 1873-74, and was almost exclusively used during the Arctic expedition in 1875-76, in both cases giving great satisfaction.

By far the largest quantity of tea consumed in Great Britain—and, in fact, all over the world—is grown in China; but very large quantities of Indian tea are now imported, and it is rapidly increasing in public favour. Attempts were made to introduce the cultivation of tea into India as early as 1823, but they were only moderately successful until the East India Company, in 1848, made several tea plantations on the southern slopes of the Himalayas and in Assam. Even in 1863 the production of Indian tea only reached 2,500,000 lbs.; but since that time the cultivation of the plant has increased to such an extent that at the present time more than 80,000,000 lbs. of Indian tea are annually imported into this country alone, and it has become, at the same time, in no small degree the beverage of the Indian population. Only a small proportion of the total available area has, however, as yet been brought under cultivation; so that we may confidently look upon this great increase as but the prelude to an enormous extension of an industry which, in the lapse of years, is probably destined to render England wholly independent of China for the supply of this wholesome beverage. A most gratifying feature in connection with this branch of the trade is that no adulteration of any kind is ever practised in India. It is an ominous fact for the Chinese growers too, that whereas formerly the increased demand for tea in Great Britain was shared by both China and India, of late years the consumption of China tea has been declining, the whole increase coming from India. The rapid increase in the importation of tea from India is shown in the following table:—

1866, ...	5,413,000 lbs.
1870, ...	12,924,000 "
1876, ...	27,814,000 "
1879, ...	39,236,000 "
1884, ...	66,084,947 "
1886, ...	80,987,351 "

A considerable quantity of tea is also now procured from Japan; and in the United States nearly half the consumption is from that country.

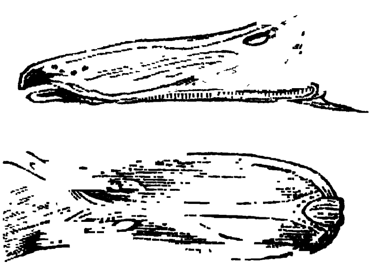
TEA, PARAGUAY. See MATÉ.

TEAK (*Tectona grandis*) is a tree, valuable for its timber, belonging to the order VERBENACEÆ. It is a native of Southern and Central India, extending into Burma, Pegu, and some of the adjacent islands, and has been naturalized in other parts of India and Ceylon in which it is not indigenous. The teak is remarkable for its size and beauty. It attains a height of 200 feet. It has large, entire, opposite, oval or elliptical, deciduous leaves, which are so rough on the upper surface as to be useful for polishing wood, and are hoary with star-shaped hairs underneath. The small white fragrant flowers are in terminal panicles, and have a bell-shaped, five-cleft calyx, a funnel-shaped corolla with a five-cleft spreading limb, and five or six stamens inserted in the corolla-tube. The fruit is a round drupe about the size of a cherry, covered with spongy wool, and inclosed in a kind of bladder formed of the enlarged calyx; it contains a hard four-celled stone, with a fleshy, oily seed in each cell.

Teak wood is very valuable for its great weight, hardness, and durability. It is extensively used for shipbuilding, for which purpose it is imported into Britain, being practically indestructible by wear or decay. It is easily worked, but, on account of the large amount of silex which it contains, the tools employed are quickly worn away.

African teak, which was long used in shipbuilding before its origin was known, is a timber similar in its properties to the true teak, and the produce of *Oldfieldia africana*, a tree of the order Euphorbiaceæ.

TEAL (Querquedula) is a genus of DUCKS (Anatinæ), distinguished by having the bill as long as the head, narrow, with the sides parallel or widening a little at the tip, which has a small nail, the wings moderate and pointed, the tail moderate and wedge-shaped, and the toes united by a full web, the hind toes being short and very slightly lobed. The species are numerous, widely distributed over the world, but most numerous in the northern hemisphere. They are the smallest of the ducks. They are migratory in their habits, frequenting rivers and lakes, and feeding principally



Bill of Teal (*Querquedula crecca*).

by night on aquatic insects, worms, molluscs, seeds, &c. They are highly esteemed as game.

The Common Teal (*Querquedula crecca*) is found all over the northern parts of the eastern hemisphere. It is a well-known winter visitor to Britain, and a few breed in our islands, on the borders of lakes and in the boggy parts of upland moors. It is one of the smallest and most beautiful of its family. The total length is about 14 inches. The head of the male is brownish-red, the body undulated with dusky lines, and the speculum on the wings black and green. The nest is made of a large mass of decayed vegetable matter lined with down, and contains from eight to ten eggs. The flesh is very delicate. The teal was domesticated by the Romans.

The Garganey or Summer Teal (*Querquedula circia*) is a rarer British species, usually occurring in our islands on migration, but occasionally remaining to breed. It is found in Europe, the north of Africa, and Western Asia. It is larger than the common teal. The general colour is dark brown with short hair-like lines on the cheeks and neck; there is a conspicuous white streak over the eye

extending to the neck; the speculum is grayish-green, bordered with white.

The Green-winged Teal (*Querquedula carolinensis*) is a native of North America, and occurs accidentally in Europe. It is very similar to the common teal, but has a broad rich green speculum and a white crescent in front of the bend of the wings. The Blue-winged Teal (*Querquedula discors*) is rather larger, and has the head grayish, the body brownish, and part of the wings bright blue. It is found throughout eastern North America to the Rocky Mountains.

TEALBY BEDS, in geology, a thin series of sandy clays and limestones, representing the middle NEOCOMIAN formation in Lincolnshire, and so called from their typical development in the neighbourhood of Tealby. They are very fossiliferous, yielding, among other shells, a large scallop (*Pecten cinctus*) and a cephalopod (*Crioceras duvalii*).

TEARS. The primary function of tears is not that relief of emotional tension which, especially among women and children, is their most prominent characteristic. The first office of tears is a much more humble one, to continually wash the eyeball and keep it free from dust, and to assist in the lubrication of the surface, so that it turns easily in its socket and retaining integuments. Tears are secreted by the lachrymal glands, which are at the outer corner of the eye. Having served their office of bathing the eye, they are wiped off by the unconscious "blinking" of the eyelid and collect at the inner corner of the eye, where a duct carries them off into the cavity of the nose. When the duct is not free the tears do not escape, and overflow on to the cheek. Persons annoyed by this defect usually remedy it by a tiny silver pin inserted in the duct to keep it open, the tears being able to pass round the head of the pin without difficulty. The usual cause of visible tears is, however, their overabundant secretion, a greater flow of liquid being poured out into the eye than the small duct suffices to carry away. This excessive flow is the result of reflex action arising from physical stimulation, irritation of the conjunctiva, inner nose, tongue, &c., or exposure to bright light; or the action is direct, and arises from emotional agitation acting immediately upon the nerves. In fact the modes of stimulation much resemble those of the saliva in their general characteristics. Tears themselves are also not unlike saliva in constitution, forming a faintly alkaline fluid yielding about ·01 of solids, a very small part of which consists of proteids, the greatest constituent being common salt.

Fishes have no lachrymal gland, and the aquatic mammals (whales, &c.) follow them in this characteristic.

TEA'ZEL, TEA'ZLE, or **TEA'SEL** (Dipsacus), a genus of plants of the order DIPSACEÆ. There are about a dozen species, natives of Europe and Northern Asia. They are prickly biennial or perennial plants, with coarse, deeply-toothed, opposite leaves, and oblong flower-heads surrounded by an involucre of several narrow bracts; the individual flowers are separated by bracts, which appear as strong prickly scales when the seeds are ripe. The Wild Teazel (*Dipsacus sylvestris*) is a native of the southern parts of England and Ireland, and is also found in Central and Southern Europe and in Russian Asia; it has become naturalized in some parts of the United States. It grows to from 2 to 6 feet high, and has long lance-shaped leaves, the upper ones adhering by their bases so as to form a cup, which is generally found full of water. It has numerous cylindrical heads of pale purple flowers, the bracts separating the latter terminating in a long straight point.

The Fuller's Teazel (*Dipsacus fullonum*) is generally considered to be a variety of the wild teazel, from which it differs in having a longer flower-head, with a shorter involucre, and in the bracts being stiffer and having their points hooked instead of straight. The flower-heads, the teazels of commerce, are, when ripe, about 2½ inches long and 1½ in diameter, and are clothed with regular strong, sharp, recurved hooks. They are used for the purpose of forming a species of brush, with which the finer hairs of the woollen fabric are drawn to the surface, where they produce what is usually called the *nap* of the cloth. The teazel is fixed in regular order upon cylinders, which are made to revolve in such a way that the hooks come into contact with the surface of the cloth and draw out some of the fine fibres of the wool; these are afterwards shorn smooth, and leave the cloth with the fine velvet-like nap which is its peculiar appearance.

Teazels will thrive in any soil, but they grow strongest and best in a stiff loam. They require the ground to be in good condition, and are supposed to exhaust it much; but no great portion of manure is required to obtain a good crop. The seed is sown in spring, and the plants thinned out to a foot or 18 inches apart. The flower-heads are ready to be cut in August of the following year. The wild teazel which grows in hedges is of no use to the cloth-worker, from the weakness of the scales, which break off, instead of drawing the wool out of the surface of the web.

The growing of teazels is a peculiar trade and a hazardous speculation, for the crop is very precarious. They are cultivated in many parts of Europe, and to some extent in England.

TECHNICAL EDUCATION is a subject which has recently occupied much attention in Great Britain. The name is derived from the Greek word *technē*, art, and means special instruction and training for the industrial arts. The Paris International Exhibition of 1867 revealed the fact that some foreign countries were improving more rapidly in different manufactures than ourselves; and from reports of experienced men of business and professors of science, who have investigated the subject in several countries, the cause of this appears to arise in a great measure from the want of provision for the regular cultivation of the intelligence of English, Scotch, and Irish skilled workmen, and for their special instruction in the principles of their work. The generality of English artisans, though equal and in many instances superior in natural shrewdness to men of any other nation, have never been systematically taught to reflect upon the matters and processes of their handicraft, and are commonly quite ignorant of its scientific relations. The Prussian, Saxon, Bavarian, and Swiss governments, having long since perceived the importance of this subject with regard to the commercial and industrial prosperity of their respective states, have taken care to set on foot appropriate schools and colleges, with stipends and exhibitions for poor students of good promise, the cost of which is sure to be ultimately well repaid to the public by augmenting the trade and wealth of those nations. The French government, likewise, has more recently turned its attention to the same means of promoting the social welfare of the people; and several great private manufacturing establishments in France have actually set the example of undertaking to provide both elementary and technical education for the families of those they employ.

The subject has not been altogether neglected in England, for as early as 1853 the Society of Arts appointed a committee to take into consideration how far, and in what manner, they could aid in the promotion of a more general and systematic cultivation of arts, manufactures, and commerce. Much important information was collected on the matter, and all the teachers, merchants, and manufacturers who were examined were very strongly in favour of adding the scientific and technical element to the education of the country. In 1859 the Committee of Council on Education passed a minute establishing a system of scientific instruction in the schools receiving government aid, and prizes are now given to teachers and pupils for proficiency in the following subjects:—(1) Practical and descriptive

geometry, with mechanical and machine drawing and building construction; (2) physics; (3) chemistry; (4) geology and mineralogy (applied to mining); (5) natural history. The result of this system has been the establishment of a large number of evening classes at schools in different parts of the country, which are attended by both adult and juvenile pupils, nearly all of them belonging to the working classes. There are also, in various places, many private establishments for a higher class of students, where technical subjects are well taught, and where nearly every mechanical trade is practised in suitable workshops. Especially is this the case at the Chester Training College, where even a steam engine can be made complete on the premises. The Watt Institution at Edinburgh and the Edinburgh School of Arts—the latter of which was established in 1821—may also be mentioned as institutions in which technical education has been imparted for many years with great success to from 700 to 800 pupils per annum.

In the year 1868 a valuable and important incentive to the development of technical education in the United Kingdom was supplied by the munificence of a private individual—Mr. (afterwards Sir) Joseph Whitworth of Manchester, who set apart £100,000 for the perpetual encouragement of young students of mechanical and engineering science. His plan was that the interest of the above sum, which amounts to over £3000 per annum, shall be devoted to the maintenance of scholarships, tenable for either two or three years, as circumstances may render most advisable. The competition is open to all her Majesty's subjects, whether of the United Kingdom, India, or the colonies, not exceeding twenty-six years of age, and of sound bodily constitution. The subjects in which they are examined are twofold, namely, sciences and handicrafts. The maximum number of marks obtainable by a knowledge of the prescribed theoretical subjects are about equal to the maximum obtainable by the most skilled workmanship, but a practical acquaintance with a few simple tools is required of *all* the candidates. Sir Joseph's aim was "to render the competition accessible on fairly equal terms to the student who combines some practice with his theory, and to the artisan who combines some theoretical knowledge with perfection of workmanship." The examination is in the following theoretical subjects:—Mathematics (elementary and higher); mechanics (theoretical and applied); practical, plane, and descriptive geometry; mechanical and freehand drawing; physics; and chemistry, including metallurgy. The handicrafts to be examined in are smith's work, turning, filing and fitting, pattern-making and moulding. The examinations are conducted under the superintendence of the Science and Art Department of the Committee of Council on Education, and after having obtained their scholarships the students are allowed, within certain wide limits, to use their own free discretion as to the mode of carrying on their subsequent education. Sir J. Whitworth only stipulated that the successful candidates shall be required to spend the period of holding the scholarships in the further satisfactory prosecution of the studies and practice of mechanical engineering, and pursue their studies according to the spirit of the endowment, making periodical reports of them; that the student shall state where he proposes to pursue his studies, the lord president of the council deciding if the proposal can be allowed, also whether the student's progress be satisfactory, and the manner in which it shall be tested from year to year. If the student wish to complete his general education instead of continuing his special scientific study, he may be permitted to do so. He may go to the universities or colleges affording scientific or technical instruction, or he may travel abroad.

So impressed was Sir Joseph Whitworth with the importance of encouraging young men having a mechanical instinct to more thoroughly qualify themselves in their business that in 1875 he formed a number of exhibitions in connection with Owens' College, Manchester, King's College, London, and University College, London. These exhibitions are competed for by examinations in (among other things) filing and fitting, turning, smith's work, pattern-making, and moulding. The successful candidates are rewarded in such a manner as to give them many additional facilities and encouragements for attaining the still more lucrative scholarships.

In 1875 technical education in England received a further impulse through the foundation of the City and Guilds of London Institute for the Advancement of Technical Education, which was started by the Livery Companies of the city of London as a means of diverting public attention from their gross misuse of their enormous revenue. This institute has since become a great Technical University, both teaching and examining. Its chief teaching functions are exercised in connection with its Technical College at Finsbury, the South London School of Technical Art, and the Central Institution of South Kensington, for the latter of which a building fund of £100,000 was subscribed, and £25,000 a year promised for its support. In examining, the institute has taken over the technological examinations from the Society of Arts, and it holds examinations all over the kingdom in the science and practice of all the chief industries of the kingdom, from brewing and telegraphy to cotton spinning, weaving, and iron and steel manufacture.

In 1881 the whole question of technical education was made the subject of inquiry by a royal commission appointed for that purpose by the House of Commons. Its first report was issued in February, 1882, and its final report in May, 1884, the latter dealing with the whole of the work of the commission, and being therefore complete in itself. The final report, which forms a storehouse of valuable information upon the subject, deals with the technical education of the Continent, gives an account of visits to numerous Continental factories and workshops, treats of the schools, museums, and other institutions in Great Britain having a technical bearing, and adds the conclusions drawn by the commissioners from their investigations and their recommendations founded on those conclusions, other branches of the subject being dealt with in separate appendices issued subsequently. It is satisfactory to know that while the commissioners were compelled to recognize that in some respects the countries of Germany, France, and the United States of America had obtained a start in advance of Great Britain, yet they found that the industries of the latter were still at the head of the industrial world, and that this fact was recognized even by the continental manufacturers themselves. The commissioners pointed out in their report the necessity for further advance in the work of technical education if this country is to maintain its position in the future; but they were of opinion that Great Britain already possessed considerable opportunities for theoretical instruction in the technical sciences and in art as applied to industry, and that all that needed to be done could be done without abandoning the existing lines. A National Association for the Promotion of Technical Education in the United Kingdom was established in 1887, with Lord Hartington as president.

TEES, a river of England, rises in Cross Fell, on the borders of Westmorland and Cumberland, flows E.S.E. (through Teesdale) and north-east, separating the counties of Durham and York, and passing the towns of Barnard Castle, Yarm—to which the tide ascends—Stockton, and Middlesborough, to the North Sea. At the latter town it expands into a broad estuary known as Tees Bay. It is navigable to Stockton for ships of 60 tons burden. Its length is about 95 miles, and the area of its basin 744 square miles.

TEETH (Lat. *dens;* Gothic, *temthus;* Gr. *odous odontos*). The organs of prehension and mastication, situated in the jaws of mammals, have a very complicated structure. The parts entering into the composition of the teeth are three: *dentine* or *tooth substance*, *enamel*, and *cement*, or more properly *tooth bone*, also called *crusta petrosa*. The enamel invests the more prominent parts of the crown, from which points it gradually diminishes in thickness till it terminates in a line on the neck of the tooth. The cement, or dental bone, is thickest at and near the end of the root, and gradually becomes thinner as it advances towards the crown of the tooth. In a tooth that has been used for some little time the cement terminates where the enamel commences, but there is reason to believe that a thin layer is continued over the enamel. Of these tissues dentine forms the great bulk of the tooth. The pulp-cavity occupies the centre of the dentine, and on its surface are superimposed the enamel and the tooth bone, the former investing the crown and the latter the surface of the fang. These two tissues form a layer of variable thickness in different parts of the teeth. This layer, however, is soon worn off when the tooth comes into use. If the enamel and cement be removed and the dentine alone allowed to remain, the tooth still retains much of its original shape, losing most at the two extremities. In point of size the loss sustained is comparatively slight; thus showing the dentine to constitute by far the greater portion of the tooth.

From the hardness of the teeth they are not capable of growing, so as to fill up the increased size of the jaws in after years. Hence we see a growing child come to have spaces left between its teeth, as they are removed from one another by the elongation of the jaw. About the end of the seventh or beginning of the eighth year a third grinder on each side of each jaw makes its appearance, which is the first permanent tooth, and never changes. When this one is rising above the gums the central incisors of the under jaw are becoming loose. If a jaw-bone be dissected at this period, and its outer part be filed away, a very beautiful preparation is obtained. The first teeth are seen in their places, and the second set are seen deep in the jaw, below, and rather behind them, ready to rise up and supplant them. (The figure represents the right half of the lower jaw, containing the five milk teeth, and filed away so as to display the bags in which the second set are contained.) It is, however, quite a mistake to suppose that

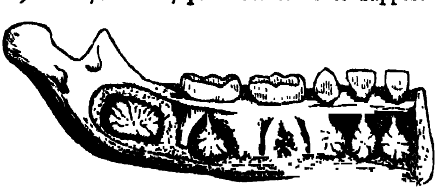


Fig 1.—Section of Infant Jaw.

the new teeth push out the old; the fact is that they cannot get up until the old ones be removed. Preparatory to the removal of the old ones, their fangs become absorbed, so that they are not a quarter of an inch in length; whereas had they been examined some months sooner they would have been found three times as long.

In man the teeth are called, according to their shape, *incisors*, *canines*, *bicuspids*, and *molars;* and these terms have been applied to the teeth of all mammals, except that those answering to the bicuspids in man are called *premolars* or spurious molars. A tooth is divided into a crown, a neck, and a fang or fangs. Other shapes are designated *tusk*, *chisel*, *tooth*, *tubercular*, *sectorial*, &c. The vascular bodies which assist in their development are known as *pulp* and *capsule:* the body of the tooth or dentine is formed by the pulp; the enamel and cement originate in the capsule. The teeth therefore are not bones, nor in any way connected with the bony framework or skeleton; they are akin to hairs, nails, &c., and are, in fact, products of the skin.

Man has thirty-two teeth; so have apes and the true ruminants, and this would seem to be the average number for the Mammalia, but Professor Owen concludes that the original typical number was forty-four.

In mammals teeth are confined to the maxillary and premaxillary bones. They are invariably fixed in sockets, and in this class only may be so fixed by more than one fang or root. The deciduous teeth, which are developed when the young are suckling, are frequently called *milk teeth.* [See DENTITION.] Few fishes are devoid of teeth; but on the other hand, in the class of reptiles, we find the chelonia, the toads, and some extinct genera of lizards to be toothless. Among the mammals the ant-eaters are without teeth. The rodents have mostly twenty teeth, though hares and rabbits possess twenty-eight.

Most quadrupeds resemble man in that they have two sets of teeth; but those whales which possess teeth, the sloths, and some other quadrupeds, have but one set. Strange peculiarities mark the succession of the teeth in some animals. Thus the guinea-pigs actually shed their milk or first teeth before they are born. Still more curious is the case of the whalebone whales. In their adult state these animals have no teeth, but the teeth are actually developed in the gums, and absorbed before birth. So also with the upper front teeth of ruminants, or animals which, like sheep, oxen, &c., "chew the cud." These front teeth are duly formed and developed, but they do not cut the gum, and wholly disappear before the animals are born. "What," asks Mr. Darwin, in speaking of this subject, "can be more curious than the presence of teeth in fœtal whales, which when grown up have not a tooth in their heads; or the teeth which never cut through the gums in the upper jaws of unborn calves?" The only explanation which has been tendered of such anomalous and apparently useless organs, has been to assume that they are the results of "the law of inheritance," and exist as the modified remnants of teeth which in the "remote ancestors" of the whales and calves attained a large and typical development. Man's teeth form an unbroken series in each jaw—a character almost peculiarly human, since only one living animal, a little lemur (Tarsius), and one extinct hoofed quadruped, the Anoplotherium, have the teeth so arranged.

Man's teeth are by no means numerous when compared with the numbers represented in some of his nearest allies, as well as with those developed in many lower forms of life. Some dolphins exist in which over 200 teeth are developed; while some armadilloes have ninety. On the side of limitation in numbers may be mentioned the curious dolphin-like animal the narwhal, or sea unicorn, in which but two teeth are found. One of these is developed to a length of 10 feet or more, like a beautiful twisted ivory rod; the other usually does not appear outside the skull. In man and many higher mammals

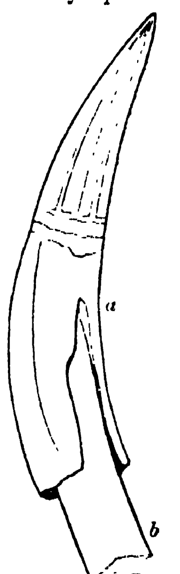


Fig. 2.—Growth of Tooth of Crocodile.

(a) Tooth fully developed; (b) tooth nearly developed, to succeed a, (c) germ of

the second teeth, if lost, are not replaced. But in the crocodile at least three teeth are always in existence, fitting one inside the other telescope-wise. Strongly contrasted with the comparative paucity of man's teeth is the dentition of most predatory fishes. In the mouth of the pike, for example, teeth cover not only the jaws, but the tongue, palate, and cheeks, even to the throat. The jaws of a shark give a beautiful pattern in teeth of the character of a mosaic.

Some teeth, such as those of sloths and armadilloes, have no enamel. In the molar teeth of the elephants, on the contrary, we meet with a very complicated structure. In these animals a molar tooth exists as an elongated body, composed of plates of dentine capped by enamel, and separated by masses of cement. The patterns assumed by the

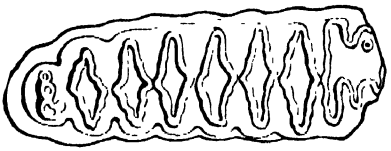


Fig. 3.—Molar Tooth of African Elephant.

dentine and enamel plates exhibit variations in the different species of elephants. Thus in the African species (fig. 3) the teeth exhibit lozenge-shaped spaces, whilst the molars of the Indian species (fig. 4) show a simple transverse or

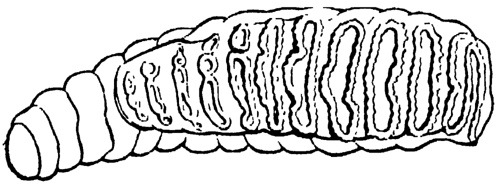


Fig. 4.—Molar Tooth of Indian Elephant.

cross-barred arrangement, also witnessed in the teeth of the extinct mammoth. In the elephants we note a good example of the immense development, as in the narwhal already noticed, of certain teeth—the upper incisors—to form "tusks." Such tusks spring from what are termed *permanent pulps*—that is, the roots of these teeth do not, as in man and most other animals, become sooner or later absorbed, but continue in a soft living condition, which permits of a continuous increase taking place. In the same way the incisor teeth of such animals as rats, mice, rabbits, hares, squirrels, porcupines, beavers, &c. (named collectively *Rodents*), continue to grow throughout life, and thus to provide for the constant wear and tear to which these teeth are subjected in the act of gnawing. To keep these incisors always sharp the front part of each incisor tooth in the rodents consists of a thick layer of *enamel;* the hinder part of the tooth being composed of the softer *dentine*, or "ivory." It follows, therefore, from this arrangement of tooth-substance that the ivory, or hinder part of the tooth, will wear faster than the enamel front, and leaves a chisel-like edge of the latter, thus providing for its continual sharpness.

A curious and very rapid alteration of the shape of the human jaw is now taking place in England. In the memory of the present generation of dentists the normal shape of the jaw has changed from a curve approaching a semicircle to one of the character of a Gothic arch, the hardness of the teeth at the same time being marked by degeneration. Large investigations show these to be the typical modes of development of the "educated" jaw; and, indeed, the contrast with the wide row of hard white grinning ivories presented by a merry negro with the almost rabbit-like prominence of the two incisors and the weak and badly nourished teeth in the mouths of children of cultured ancestry, is so marked as inevitably to strike the attention of the most careless observer.

Diseases of the Teeth.—From their peculiar position and surroundings the teeth are liable to sundry mechanical injuries and to several forms of disease, the latter being capable of causing serious disturbance of the nervous system and much pain and inconvenience. The diseases attendant upon the growth and development of the teeth have already been noticed under DENTITION, and the most common pathological change to which they are liable has been described under CARIES. Among the remainder, perhaps the more important are the following:—

Loosening of the teeth, also known as spongy gums or "false scurvy," is an affecton which appears sometimes as a result of crowding of the teeth, dyspepsia, too frequent pregnancies, the use of mercury or iodide of potassium, but which also at times arises without any discoverable cause. It is characterized at the outset by an enlargement and protrusion of the gums, but afterwards, while the gums remain thickened at the edges, they recede from the necks of the teeth, which consequently appear elongated. During this process the gums bleed freely on the slightest friction, a purulent discharge is given off at their edges, tartar forms around the necks of the teeth, and the breath is generally more or less offensive. The teeth also become loose in their sockets, and should the disease be prolonged are liable to drop out. The treatment of this affection consists in the removal of any irritating cause, in careful attention to the general health, and in the use of suitable local applications. All tartar should be removed from the teeth, and although this operation will cause considerable bleeding, it is probable that the latter will have a salutary influence rather than otherwise. The teeth should be frequently brushed with a moderately stiff tooth-brush, the bleeding of the gums on such occasions being beneficial, and the mouth should afterwards be rinsed with a little alum and water or other astringent mouth wash.

Necrosis of the teeth is characterized by blackness of the teeth and then looseness in their sockets, together with a peeling off and wasting of the gums, and it may arise as a secondary malady after small-pox, scarlet fever, and measles. It also arises from inflammation of the pulp, or secondarily as a result of necrosis of the jaw. The treatment of such cases must be directed towards the general health of the patient, the local measures consisting for the most part of attention to cleanliness and deodorization.

Toothache.—This term can hardly be used as the name of a disease, seeing that it is commonly applied to any pain in or immediately around a tooth, without distinction as to its cause or character, and it must rather be taken to designate a symptom of various diseases of the teeth and of their contiguous parts. In the majority of cases the pain is dependent upon the inflammation of the pulp of the tooth, of the nerve-twig entering the pulp cavity, or of the membrane which invests the roots. Where a tooth has become decayed and the decay has reached the pulp, the use of sweet, sour, or salt articles of food is apt to give rise to considerable pain, and the use of hot or cold liquids, a draught of cold air, or a bodily chill may also cause much suffering. The pain, which is at first of an acute character, afterwards becomes more or less intermittent, involving sometimes the whole of one side of the face, and lasting from a few hours to several days, or, with intermissions, for a much longer period. Very frequently, in addition to the toothache, the tooth becomes exquisitely tender, and it often feels as if it were longer than the others. Sometimes the tooth pulp becomes inflamed without any apparent cause and without any visible decay in the surrounding enamel, and in such cases, owing to the pressure of the unyielding walls by which it is surrounded, the pain may be

very severe. At other times, though more rarely, small bony tumours are developed within the pulp cavity or upon the outside of the fangs, which from their pressure upon the nerves cause the most severe suffering, which only extraction can remove. Inflammation and suppuration round the roots of a tooth cause toothache of a severe character while the matter is forming, but the pain is much alleviated when the attendant abscess bursts and the matter finds vent into the mouth. The treatment of toothache consists in attendance upon the general health, in the use of local applications, and in the extraction of the offending organ. Where toothache arises from debility, tonics, especially quinine, are often useful, and an attack of the pain may be alleviated temporarily by the use of food and stimulants, wine being the most useful form of the latter. The toothache caused by a low condition of bodily vigour is usually of a diffused, wandering, and neuralgic character, and its severity is increased mitigated by the general condition of the patient. Where the pain is associated with indigestion, the bowels should be well relieved and the patient should adopt spoon diet for a time, a little nux vomica being also taken to give tone to the digestive organs. With respect to local treatment, where toothache arises from the decay of the tooth, the pain may be relieved by the insertion into the hollow of a small piece of cotton wool that has been saturated with chloroform; the preparations of camphorated chloroform, chloroform and laudanum, or chloroform and creosote, may also be used in a similar way. Other remedies are creosote, laudanum, laudanum and tannin, laudanum and creosote, camphor and opium in equal parts, and chloral and camphor, these drugs in all cases being used in small quantities for insertion into the hollow tooth. For cases where the pulp is exposed and inflamed a mixture of carbolic acid and collodion may be employed with advantage, a drop or two being put upon cotton wool and inserted into the tooth. The preparation and use of this remedy, however, requires skilled assistance, and care must be taken not to allow it to touch the gums, tongue, or inside of the cheek, or considerable pain and smarting will insue. A plug of lint dipped in sulphurous (not *sulphuric*) acid, and inserted into a hollow tooth, will also in many cases afford an immediate relief of the pain. In cases where the decay has only proceeded a little way, toothache may be prevented and the tooth may be preserved for a considerable period by careful stopping; but where the caries is too extensive to allow of this, extraction is often the only effectual means of preventing the pain. In cases where the gums are hot and swollen the pain may sometimes be relieved by causing them to bleed freely. A pepper plaster or bag of hot salt applied to the cheek are homely remedies which are often effectual.

Hæmorrhage after tooth extraction, which is sometimes troublesome and prolonged, may be checked by plugging the cavity with lint or cotton wool previously steeped in perchloride of iron, solution of tannin, tincture of matico, red-gum, or turpentine. This application may, if necessary, be kept against the bleeding surface by means of a compress of lint or a piece of cork pressed upon by the teeth in the opposite jaw. In severe cases the internal use of such astringents as turpentine, ergot, or tannin may also be necessary.

In conclusion, it may be observed that diseases of the teeth may give rise to severe nervous affections, such as locking of the jaw through contraction of the masseter muscle, epilepsy, wry-neck, muscular paralysis, facial paralysis, and even amaurosis and permanent loss of sight.

TEETO'TALLERS. See TEMPERANCE MOVEMENT.

TEG'EA, an ancient city of Arkadia which for generations resisted the arms of Sparta. An oracle declared that the success of the brave town was due to its possessing the bones of the hero Orestês. These, therefore, by a stratagem, the Lacedæmonians obtained, and the knowledge of their fulfilment of the oracle added as much vigour to their attack as it drew courage away from the baffled Tegeatans. But though the latter now fell before their foes (about 560 B.C., as far as one can fix a date), they were never altogether subdued, like the town of Mantinea and the rest of Peloponnêsos. The Tegeatans rather kept the position of dependent allies, and retained an almost complete autonomy. They fought bravely against the Persians when the independence of Greece was won at Plataiai (B.C. 479), and stood shoulder to shoulder with their masters all through the Peloponnesian War; but afte the overthrow of the Spartan supremacy of Greece at the battle of Leuktra (B.C. 371), they headed Arkadia in regaining their independence.

Tegea had a famous temple of Athena, and when this was burnt down they engaged the famous sculptor and architect, Skopas, to rebuild it (about B.C. 400), under whose direction the largest and most splendid building in the Peloponnêsos arose. The temple and the city were renowned down to the times of Strabo and Pausanias.

TEGUEX'IN (Teius) is a genus of LIZARDS belonging to the family Ameividæ. This family contains large reptiles, natives of the warm parts of America. The head is covered with large regular shields, and the back with rhombic scales, and there are transverse rows of square scales on the belly. The skin of the throat generally forms two or three transverse folds. The limbs are well developed, and the tail is generally long and rounded. The Common Teguexin or Sauvegarde (*Teius teguexin*) is a native of the greater part of South America, ranging from Guiana to Paraguay, and frequenting wood sugar

The Common Teguexin (*Teius teguexin*).

plantations, and dry plains. It is strong and swift, and when attacked by dogs it sometimes defends itself with its powerful tail. Usually when pursued or alarmed it takes to the water, where it remains till the danger is past. It feeds on insects, frogs, snakes, the eggs and young of birds, &c. It is also said to be very fond of honey. The flesh is said to be palatable, and the eggs, which are nearly as large as a fowl's, are relished by the natives. The Teguexin is about 38 inches long, growing sometimes to a length of 4 feet 6 inches. The colour is variable. The back is of a black ground colour, with brownish and yellowish spots, either scattered or disposed in cross bands; the lower surface is yellow, banded with

black, and the tail, which is long and cylindrical, somewhat compressed towards the tip, is ringed with yellow and black.

TEHERAN', the capital of Persia and seat of government, is about 15 miles in circumference, surrounded by a bastion enceinte, the work of a French engineer, stands on a barren elevated plain, about 70 miles from the Caspian. Its mosques, colleges, and caravenserais are in good repair; it has well-furnished shops and bazaars, and some palaces of the Persian nobility. Teheran has been enlarged and improved very considerably by the present shah. There are five royal palaces in the city, which is nevertheless very unhealthy in summer, when the court retires to Sultaniyeh, about 150 miles to the north-west. Some of the most striking buildings are the residences of the foreign legations. There is a fashionable drive, a racecourse, and some very fine roads, while several telegraph lines centre here. The population varies from 70,000 to 120,000, according to the presence or absence of the court and the season. In the neighbourhood are the ruins of Rai, the Rhagæ of the ancients, and once the capital of the Parthian Empire. The shah and the wealthier inhabitants withdraw to tents on the plain nearer the foot of the Elburz Mountains.

TEIGN'MOUTH, a port of England, in the county of Devon, situated at the mouth of the Teign, 15 miles south from Exeter, and 209 from London, is much frequented as a bathing-place, the climate being very mild and salubrious, and the country around very beautiful. In front, on the sea side, is a wide esplanade known as the "Den," a huge bank of sand accumulated in the course of ages at the river's mouth, and now a public lawn, which forms one of the chief features of the place. In addition to this a promenade pier was erected in 1866. The town has many good hotels and lodging-houses, several churches and chapels, market-house, assembly rooms, free schools, library, theatre, and infirmary, and a small harbour, with some coasting trade, and with Newfoundland fisheries. Teignmouth is connected with Shaldon, on the opposite side of the river, by a wooden bridge, 1671 feet long (the longest wooden bridge in England), with a swing in the centre allowing for the passage of vessels. There are considerable exports of granite, pipe-clay, potter's clay, timber, bark, and cider; the imports are culm, coal, deals, iron, &c. There is a considerable fishery for soles, whiting, turbot, mackerel, and pilchards, on the coast, and for salmon in the river Teign. The town consists of two parishes: East Teignmouth (population 2482), and West Teignmouth (population 4638). Teignmouth is of high antiquity, and is said to be the place at which the Danes first landed in 787. It furnished its quota of men and ships to the siege of Calais in 1347, and was thrice burnt by the French, twice about that time and again in 1690.

TEINDS. See TITHES.

TEIRE'SIAS, a very famous figure in Greek myths, because of his power as a soothsayer, was a native of Thebes. He was struck blind in youth, and there are two legends as to the cause of this. The more usual one relates that Teiresias was handsome as a youth, and a favourite with the wood nymphs; being changed by a miracle into a woman, through serpent-magic, he became equally beloved by the youths of his district. But he rested not until a repetition of the serpent-magic restored him to manhood. Thus peculiarly qualified to judge of both men's and women's minds and affections, he was universally resorted to for advice. Even the gods sought knowledge of him, and a question having arisen between Zeus and his consort Hera, the matter was referred to Teiresias, who gave it as his experience that in love, the point in dispute, women received more than she gave. This so enraged Hera that she struck her too-just judge blind. Zeus, unable to reverse the cruel decision, granted Teiresias, as a compensation, the gift of prophecy and the knowledge of the language of animals, as well as a life longer than had ever been enjoyed by mortals, lasting, indeed, more than two centuries. He met his death by drinking at a well when over-heated, flying with the Thebans from their victorious enemies the Epigonoi. The way in which the assumed universal knowledge of the seer is explained by his relations to men and women, mortals and gods, and his appearance as a chief agent in myths separated, on their own showing, by many generations, by his abnormally long life, is most ingenious. Even after death, among the shades, the ghost of Teiresias wandered with golden staff in hand, he alone retaining his full powers of perception and prophecy.

The other legend is that Teiresias, as a lad of seven years old, wandering in the woods, came upon the virgin-goddess, Athena, bathing, and stood gazing at her loveliness until the goddess turned and saw him. Dashing water in his eyes she cursed him with blindness for his presumption. One of her nymphs, struck with pity for the handsome lad who had meant no harm by his accidental offence, begged hard for mercy for him, and Athena relented. Unable to undo her own act she yet made up for its cruelty by granting Teiresias the power to prophesy and to understand the voices of birds, and gave him a golden staff, which guided his steps as safely as if he saw.

TEL'AMON, in Greek myth, was a son of Aiakos, who for assisting his brother Peleus to murder their half-brother, Phokos, was expelled from Ægina. He took refuge in Salamis, and marrying the king's daughter, became eventually King of Salamis. By his first wife he was father of Ajax (Gr. *Aias*), one of the chief heroes of the great Trojan War, hence called usually *Aias Telamônios*, and sometimes "Ajax the Greater," to distinguish him from a less famous namesake. Telamôn was one of the hunters of the Kaludonian boar with Meleagros, and one of the Argonauts with Jason. He accompanied his great friend, Heraklês, on many expeditions; helped him to take Troy at the first capture of that devoted town, and then married a Trojan princess, daughter of King Laomedôn, who bare him the hero Teukros, renowned as the best archer among the Greeks at the siege of Troy. Telamôn was also with Heraklês against the Amazons, the Meropids of Kos, &c.

TELAMO'NES, in architecture, colossal figures of men employed for the purpose of supporting entablatures, and so called in allusion to the gigantic strength of the Greek hero Ajax, son of Telamôn.

TELE'DU (*Mydaus meliceps*) is a small carnivorous mammal belonging to the family MUSTELIDÆ. The teledu is peculiar to Java and Sumatra, being found only on mountains at an elevation of 7000 feet above the sea. It is about 15 inches long, and has a stoutly built body, with short thick semi-plantigrade legs, and a very short tail, measuring about half an inch. The head is pig-like, the muzzle being produced, and the ears are rudimentary and surrounded by a tuft of long hairs. The colour is dark brown, with a white band extending along the back. Like the skunk of North America, the teledu emits a most offensive odour by ejecting a volatile secretion from two oval glands situated near the anus. The teledu forms a burrow in the earth, within which it remains concealed during the day, coming forth at night in search of its food, which consists of earthworms and insects and their larvæ. It is rather slow in its movements, and very gentle, so that when taken young it is said to be easily tamed. The flesh is said to be very delicate when precautions are taken not to allow it to become impregnated with the offensive odour.

TELEG'ONOS, son of Odusseus (Ulysses), by the sorceress Kirkê (Circe), was innocently the cause of his

father's death. Kirkê sent her son, when he had arrived at manhood, to find her long-lost lover, and bring him back to her if possible. Telegonos (whose name means "the far-away begotten") traced Odusseus towards Ithaka, and was cast upon that very island by a shipwreck, having thus reached his destination, though he knew it not. Driven by hunger he ravaged the land, and the king hearing of this set out to punish the intruder, accompanied by his son Telemachos. In the struggle Odusseus fell by the hand of Telegonos, and the latter learned when it was too late the crime he had committed.

A myth relates that, by divine command, Telegonos atoned for his crime by becoming the husband of Penelope, in the room of Odusseus, which would imply a remarkable success in retaining the vigour of youth on the part of that renowned queen. Penelope bare Italos and Mamilia to her young husband, whence come the names of Italy and the Mamilian gens. The cities of Tusculum and Præneste Telegonos is said to have himself founded; for, like his father, he too was somewhat of a wanderer. The body of Odusseus he and Penelope took to Kirkê's island (Aiaia) and buried it there.

TELEG'RAPHY. From a very early period of history the importance of a rapid means of conveying intelligence between distant stations has always been recognized; thus among the Indian tribes their "runners" existed, special messengers of information. The "fiery cross," another means of circulating intelligence, existing among the warlike clans of the Highlands, and the beacon fires of the early Britons, all point to the necessity of establishing some system of conveying information with more than ordinary rapidity.

It was in 1588, three hundred years ago, when the Spanish Armada was sighted off the southern coast of England, that the beacon fires were last lighted, hill after hill flashing the intelligence over the kingdom. They have indeed once since that been lighted, on the occasion of the jubilee of Queen Victoria, 21st June, 1887, the signal for lighting having been given from the Worcestershire Beacon, situated on the highest point of the Malvern range, 1400 feet above sea-level, when almost immediately hill answered hill until all the uplands of England were alight, from the Isles of Scilly in the west to Thanet in the east, from the Isle of Wight in the south to Campril Fells in Lincolnshire, north to Scawfell Pike and Skiddaw top, and across the Cheviots on to Midlothian.

Not so many years back (1844) the government had no more rapid means of transmitting intelligence from Whitehall to Portsmouth than by the use of the semaphore, an upright post of wood fixed on the roof of the Admiralty, code signals being given by the angular movement of one or more arms worked by levers, which either singly or in combination indicated certain words or groups of words. These angular motions, being observed from the next semaphore station at Greenwich or Shooters Hill, were passed on in succession from station to station until Portsmouth was reached. It is quite obvious that such a system was useless in foggy or thick weather. Intelligence was likewise conveyed by trained carrier pigeons, but confined chiefly to the conveyance of stock exchange news between London and the bourses of certain cities and towns in Belgium, France, Holland, and Germany. Such were the general means available for the transmission of news up to 1844, when the electric telegraph first began to assume a practical form; but little encouragement was given to promote the introduction of the invention, even the Admiralty being so conservative in their opinions that they refused to recognize its value, stating that "telegraphs of any kind were wholly unnecessary, and that no other than the one in use (semaphore) would be adopted." The researches of Œrsted (of Denmark) in 1819, on the influence of an electric current upon the magnetic needle, proved to be the pioneer in the production of signals at a distant station, and after his discovery numerous attempts were made by Ampère, Sommering, Schilling, Gauss, Weber, Steinheil, Ronalds, and by Ohm in 1827, Faraday in 1831, and others, to improve the arrangements, but with little or no practical result, and so matters remained until Sir Charles Wheatstone in 1843 published in the *Philosophical Transactions* his "Investigations into the laws that regulate the transmission of electric currents through metallic conductors."

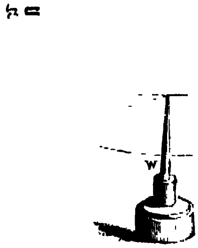
Whatever claims inventors may make, it remains an incontestable fact that Sir Charles Wheatstone was the first who succeeded in giving the electric telegraph a practical and commercial value. In 1837, in conjunction with William Fothergill Cooke, he took out a patent for an apparatus consisting of five needles, the various letters of the alphabet being indicated by the angular deflection of two needles towards the point at which the letter was marked upon the dial (Plate I., fig. 1). About the same date Morse, in America, patented his successful "dot-and-dash" recorder. In 1838 Wheatstone and Cooke had reduced the number of needles to two, and in 1845 the number was further reduced to a single needle. Simple and efficient as the apparatus now was for transmitting messages, such was the apathy of the public that no one believed in it, and for some time it was regarded more as an exhibition toy, the public paying one shilling each to send short messages from the Paddington to the Slough stations on the Great Western Railway, between which an experimental line had been erected. Not until a sensational arrest had been effected by its means was interest taken in or attention directed towards the important position the telegraph would occupy in the future.

A murder, that of a woman (in 1845), had been committed at Salthill, near Windsor, by a Quaker named Tawell. He was traced to Slough Station, and there he was found to have taken train to Paddington. The telegraph at once transmitted a description of his dress and person. On arrival at Paddington he was followed and apprehended, and afterwards tried, convicted, and executed. Even after the formation of the Electric Telegraph Company in 1846, and the opening up of the wires to the public for the transmission of messages to distant stations, little or no interest was manifested in the wonderful means of communication offered, scarcely a dozen messages being either received at or transmitted from the Central Station in Founder's Court, Lothbury, the first day. Only one person appeared seriously to realize its importance, and recognize that hereafter London would become the telegraphic centre of communication for the whole civilized world. This person was Mr. Julius Reuter, a gentleman at that time located at Aix-la-Chapelle, engaged in carrying on an express system of communication by means of carrier pigeons. On the opening of the telegraph for the public transmission of news, Reuter at once established himself in London, and inaugurated his agency system, by which at his central office he received early intelligence from various home and foreign parts, and the news so received was then offered to the press for publication; but little or no confidence was put in the veracity of the information thus placed at their option, and the various London newspapers preferred to continue their expensive system of special correspondents. In vain, month after month, was the news received under the heading of "Reuter's telegraphic despatch" offered for publication; it was as surely refused; and it was not until Reuter had offered to supply the press with information for a whole month gratis, to enable them to compare its trustworthiness with the intelligence received from the several correspondents, that he could obtain any hearing.

The London *Daily Telegraph* was the first newspaper to realize the importance of the Reuter despatch and adopt the system. After this the other daily papers were

gradually, in self-interest, forced to fall in with the system, the *Times* being the last to yield, continuing its special correspondents until fairly driven into the Reuter system by other papers appearing with priority of news. Such is the history of the introduction of the telegraph into this country for general commercial purposes; the public were apathetic and inappreciative of its value, and the results commercially appeared so disheartening that one of the leading capitalists, who had embarked enormous sums in the enterprise (Messrs. Cooke & Wheatstone receiving £190,000 for their patents) of carrying extended circuits over the kingdom, withdrew altogether from the enterprise, so discouraging was the apparent failure of public support on the opening day. It was in 1840 that Wheatstone conceived the idea of transmitting messages

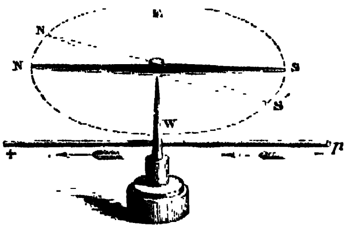
Fig. 1.



under the sea by means of a submarine insulated wire. In that year the Abbé Moigno announced that Wheatstone had found the means of transmitting signals between England and France, and adds, "I have touched with my hands the conducting wire, which, buried in the depths of the ocean, will unite instantaneously the shores of England with the shores of France."

Wheatstone's first experiment took place in 1844 in Swansea Bay, off the Mumbles Lighthouse, when signals were successfully transmitted from an open boat to the shore from a considerable distance. Between the years 1844 and 1848 railways were comparatively in their infancy, their limit of distance, in comparison with their present extent, was very small, and electrical knowledge did not keep pace with the required extension of the electric wire, it being found that the 5-inch astatic needles of the Cooke and Wheatstone system were absolutely useless for distances exceeding 150 miles. In 1848 Nathaniel J. Holmes gave to telegraphy the practical result of his researches as regarded the rapid transmission of signals over extended

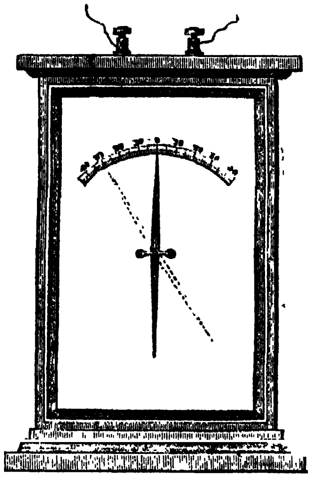
Fig. 2.



circuits, by which the astatic combination was rendered unnecessary, and the resistance of the instrument greatly reduced. The introduction of gutta-percha and india-rubber, in 1850, as insulating mediums for electrical purposes provided the means of successfully establishing the stupendous telegraphic undertakings which encircle the globe, uniting the eastern and western hemispheres; and in the present day the safe and expeditious conduct of almost all railway travelling absolutely depends upon the efficient working of the electric telegraph. The services it daily renders to society and commerce cannot be overestimated.

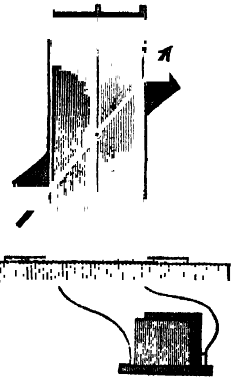
Every telegraphic system may be said to consist of three distinct portions combined together: the apparatus for sending and receiving the message, the conductors or wires which convey the electricity, and the apparatus for producing the electricity, consisting of batteries, magneto-

Fig. 3.



electric machines, &c. The discovery by Œrsted the Danish philosopher, in 1819, of the action of the galvanic current upon a magnetic needle, which has proved to be the first parent of the electric telegraph, will be understood by reference to figs. 1 and 2. When a current is passed through a conducting wire placed parallel and near to a magnetic needle freely suspended, the needle is deflected to the right or left, according to the direction in which the current is transmitted through the wire, and the position of the wire, whether above or below the needle, has an equal influence with the direction of the current in determining the deflection to the right or left. On placing the wire above the magnetic needle, the current passing from the positive pole of the battery, the N. end of the needle is deflected to the left. On placing the conducting wire below the needle the

Fig. 4.



N. end will turn to the right. A reversal in the direction of the current produces opposite effects, the same end of the needle turning to the left. The power of a single wire in causing the deflection of a needle is small, but when the needle is surrounded by several parallel coils of insulated

wire it is acted upon by the united influence of the entire series of coils. It is upon this principle that the galvanometer, or multiplier (figs. 3, 4), is constructed. It consists of a magnetized needle placed within the centre of a hollow frame wound with insulated wire (fig. 4). The external pointer indicates the direction in which the current flows, and the angle of deflection the force or tension of the current. Shortly after this discovery Arago and Ampère succeeded in rendering iron magnetic by the passage of a voltaic current through a wire coiled around it. It was found that, provided the iron was perfectly soft and pure, the magnetic property remained only during the actual transmission of the current, and that it became immediately demagnetized upon the interruption of the circuit. The discovery of the voltaic circuit, of the deflection of the needle, and the magnetization of soft iron formed the three great steps in the invention of the electric telegraph, and it remained for Messrs. Cooke and Wheatstone to combine these three essential inventions into a thoroughly simple and practical form. Their first transmitting instrument consisted of five magnetic needles arranged in a vertical position (see Plate I., fig. 1). In 1837 Morse introduced his "dot-and-dash" system of telegraphy

Fig. 5.

THE MORSE ALPHABETICAL CODE.

		p	· — —
a		q	— —
b		r	· — ·
c		s	· · ·
d		t	—
e		u	· · —
é		ü	· · —
f			
g		w	— ·
h		x	—
i		y	—
j		z	—
k		ch	—
l		Full stop	· ·
m		Repetition	· ·
n		Hyphen	—
o		Apostrophe	·
ö		Finish	—

in America. In this alphabet no letter can contain more than four characters, and every numeral must contain exactly five. A modern form of the Morse apparatus is shown in Plate II., figs. 1 and 2. In 1838 Dr. Steinheil, when constructing the first continental telegraph, between Munich and Bogenhausen, made the important discovery that th conducting power of the earth might be substituted in plac of a return wire, it being only necessary to bury in moist earth a large copper plate at each end of the circuit, and t connect it with a wire from the telegraphic apparatus at each end by which the earth circuit was formed. In 1840 Wheatstone invented an alphabetical telegraph (Plate I., fig. 4), in which the property possessed by soft iron of becoming a temporary magnet was made the means of transmitting the letters of the alphabet. H, H, are the electro-magnets; B, the soft iron armature, attached to the spindle E, and having an up-and-down vertical motion; F, a bearing to guide the spindle; P, P, clawker and driver pallets working into the teeth of the wheel A. The arl of this wheel carries the index dial D. C is a spring which keeps the armature in its normal position. N is the adjustment for the electro-magnets. The alternate attraction and liberation of the armature causes the disc D to revolve with a step-by-step movement, whereby the several letters of the message are successively presented to the eye of the observer at the distant station. This and all other 'orms of letter telegraphs have given place to the alpha-)etical telegraph of Wheatstone patented by him in 1859, and which has been very extensively used all over the United Kingdom as a means of private communication between offices and works, and also by the Postal Telegraphic Department for short circuits and intercommunication between provincial towns. The value of this instrument may be estimated when it is stated that Sir Charles Wheatstone received for his patent no less a sum than £48,000. This telegraph consists of two parts, the "communicator" for sending the message, and the "indicator" for receiving the message. The communicator consists of a small box, upon the upper surface of which is a fixed dial, having its circumference divided into thirty equal spaces, marked with the twenty-six letters of the alphabet, the three marks of punctuation, and a +, with an inner circle marked with the nine digits and a +, the figures being repeated twice. A pointer in the centre of the dial, made to move by mechanism, points (at the will of the operator) to the letters or figures required to be indicated. Round the circumference of this lettered disc are thirty small keys or buttons, which can be depressed by the finger, one for each letter or sign. In its interior the box contains a permanent horse-shoe plate magnet with coils for producing the necessary magnetic currents. An exterior handle, on revolution by the hand, causes an axis carrying a soft iron armature arranged to be in close proximity with the soft iron cores of the coils on the poles of the horse-shoe magnet to revolve, so that at every revolution of the axis with which the handle is connected, the soft iron armature passes over the poles of the magnet, and at the moment of making and breaking contact induces currents of electricity, moving in opposite directions through the wire of the coils, if the circuit be complete.

These induced currents through the coils taking place each time contact is made and broken during the revolution of the soft iron armature over the poles of the magnet, a succession of currents of electricity is obtained by the continuous revolution of the handle. The mechanism is further so arranged that when any one of the thirty keys round the dial is depressed by the finger, that key has the effect of cutting off the passage of the current along the line and through the instrument, and of making a short circuit with the earth so long as it remains depressed. When any other key is similarly depressed a simple piece of mechanism (a slack chain) causes the depression of this key to elevate the former key, open the electrical circuit, and allow the induced currents derived from the magnet to flow in succession through the instrument and along the wire to the distant station, until they are again interrupted and passed into the earth by the depressed key. This short circuit contact is made by means of a loose carrier arm attached to the axis which carries the pointer on the dial, and thrown in or out of gear by the depression or elevation of a key. Motion is communicated to this axis by a bevelled wheel working into a pinion fixed to the axis carrying the armatures, the motion being so adjusted that for every separate current induced in the coils the hand shall move one space or letter on the dial. The keys, therefore, being depressed in succession will each liberate one current, or thirty distinct currents during an entire revolution of the hand round the dial, fifteen in one direction and fifteen in the opposite direction. For every current transmitted (these currents being in succession in different directions) the hand of the communicator, and those of the indicators at the near and distant station, will simultaneously advance step by step until the letter opposite the depressed key is reached by the pointer. The instant this letter is reached a short circuit is made by the carrier; the current no longer flows through the telegraph wire and indicators, but passes into the earth until another key is depressed and the circuit is again opened, and so on in

succession until any number of required signals or letters have been registered.

The indicator, externally something like a watch in appearance, is mounted in any convenient position for observing the dial. The face of the indicator is spaced into thirty divisions like the communicator, with its double circle of letters and figures, and its movable hand or index. A step-by-step motion is imparted to this hand by means of an electro-magnetic apparatus, which consists of two permanent magnetic bars or needles fixed to an axis and lying parallel between two small electro-magnetic coils with soft iron cores. These electro-magnets are so arranged that when a current of electricity from the communicator passes through the coils their armatures exercise a mutual attraction and repulsion on the poles or extremities of the magnetic needle, the effect of which is to impart a backward and forward motion to the axis carrying the magnetic bars. Fixed to the end of this axis is a short vertical arm carrying a small escapement wheel of fifteen teeth, the axis of which carries the pointer on the dial, and to which a step-by-step motion of rotation is imparted by the escapement wheel working to and fro against fixed stops or pins. The stand of the indicator is furnished with a lever turnplate, by which the alarm for calling attention, or telegraph, can be thrown into circuit, according as the lever is turned to the one or the other. Whenever the telegraph is not in use the alarms at each end are placed in circuit, so that on turning the handle of the communicator and depressing a key the first currents transmitted through the circuit will cause the bells at both ends of the line instantly to sound, and call the attention of the clerk or operator at the distant station. This instrument is capable of transmitting more than 100 letters per minute. As the single-needle instrument then in use (1858) required great skill and proficiency to manipulate, little or no extent of private wire communication existed. The introduction of Wheatstone's "Universal Telegraph," with its magneto battery, overcame these difficulties, and a network of private-wire communication rapidly spread over every important city and manufacturing centre in the kingdom.

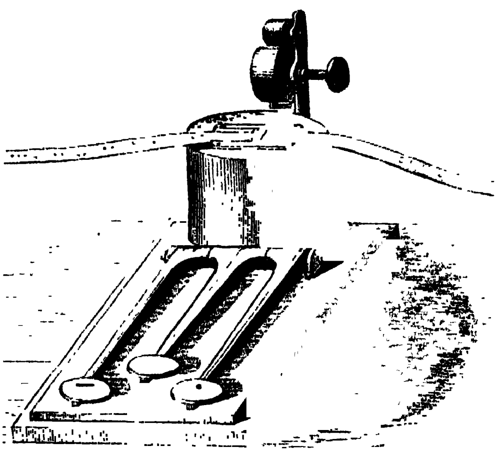
In all telegraphic transmissions along a wire the cost of manual labour per minute or hour is inappreciable as compared to the value of a minute or hour in the occupation of an extended telegraphic circuit erected at a cost of thousands of pounds. For instance, the erection of a line of poles and a single wire between London and Glasgow would entail an expenditure of at least £12,000. To obtain therefore the greatest amount of work out of such a wire in a given time is one of the chief problems of mechanical telegraphy, and commercial success depends entirely upon the speed at which currents of electricity can be sent through a wire of given length. This speed is determined by the rapidity with which they can be transmitted through the wire without coalescing, that is, without running together to form a continuous mark at the distant end. It may here be observed that in order to insure the maximum of speed in the passing of currents into metallic conductors, they require to be passed into the wire at equal intervals of time and of equal duration.

In the Jacquard loom an endless band of cards is passed successively over the register of the loom, and brought forward card by card at each throw of the shuttle, each card being perforated with holes representing a certain portion of the pattern, and each hole controlling the lifting of one or more threads in the warp. A series of weighted needles are, as the cards pass, momentarily allowed to drop through the holes, and in so doing, by a mechanical adjustment, raise the respective threads or groups of threads to the surface, so that the shuttle passes underneath, and thus the pattern thrown on the surface is automatically repeated as the cards in succession pass over the register. Now it is this Jacquard loom principle that Sir Charles Wheatstone has so beautifully employed in his high-speed "automatic" telegraph, to weave his electric currents into the circuit wire, and produce the electric pattern upon paper at the distant end in groups and sequence of groups forming letters, words, and sentences.

Wheatstone's high-speed "automatic" printer consists of three distinct parts—one for the preparation of the paper-ribbon, regulating the succession and sequence of currents to form the message, termed the "perforator;" another for passing the currents so grouped into the line, termed the "transmitter;" the third, the pattern-producing arrangement, termed the "recorder," by which the currents so passed into the circuit are transformed into symbols and printed, to be afterwards translated into words and sentences. All automatic high-speed instruments, for either submarine or land wire circuits, embrace these three essential conditions, the mechanical modification of detail alone regulating the character of the apparatus for the work to be performed.

The message to be sent is first punched out in holes arranged to represent the Morse "dot-and-dash" alphabet, on a continuous paper ribbon, by means of the "perforator," shown in elementary form (fig. 6). Each of the three finger-keys on depression perforates the paper, the right key being representative of the "dot," the left of the "dash," the centre key the mechanical spacing of the symbols, and necessary for the regular step-by-step motion of the paper ribbon through the loom or "transmitter." The

Fig. 6.

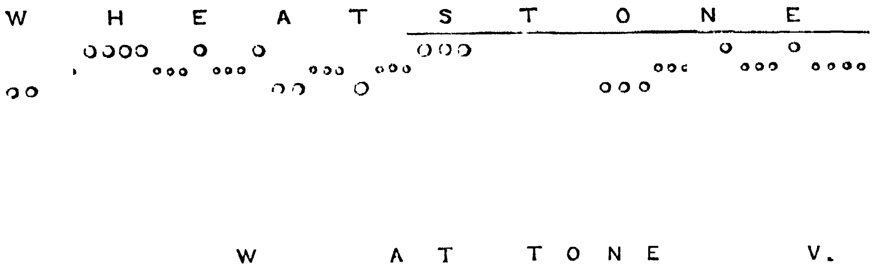


"perforator" is so constructed that upon the depression of any one of the keys a threefold action takes place. The paper ribbon in the machine is locked in position to receive the perforation; the holes are cut by the pressure of steel pins on the paper, and a mechanical movement, which at first holds the paper in the direction in which the ribbon enters, after the perforations are made automatically, carries it forward the requisite distance to receive the next symbol. Thus, by successive depression of the respective keys, the holes are cut in the paper ribbon in the necessary sequences to represent letters and groups of letters to form words. Fig. 7 shows the paper ribbon thus prepared, full size. The centre punch, besides mechanically spacing the perforations to insure their proper passing through the "transmitter," also by individual pressure spaces the distance between the letters and words of the message. Thus the message is written away from the wire, and the time taken

up in its preparation is not attended by loss of revenue incident to the slow manipulation by manual labour.

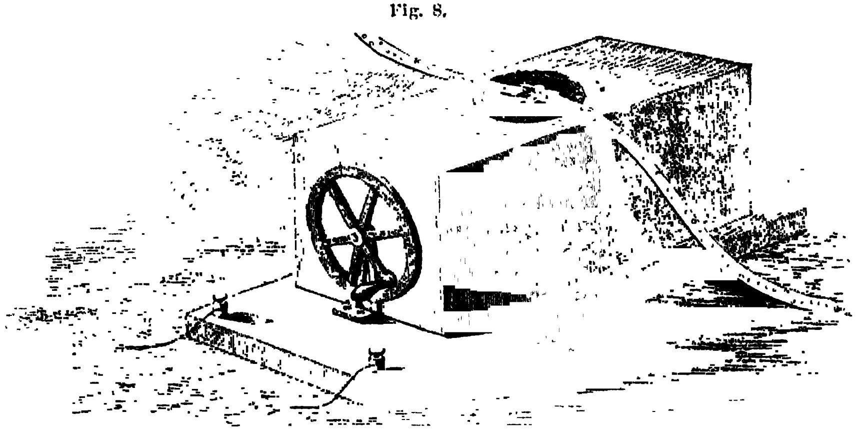
The "transmitter" of the "automatic" system (fig. 8) is the apparatus which sends into the wire the sequence of currents as prepared by the "perforator." In this process the perforated paper-ribbon strip is caused to advance step by step through the machine by the successive grip of an oscillating cradle, adjusted to advance the paper a distance exactly corresponding to the spacing of the holes by the "perforator," so that by the action of a rising central pin, elevated and depressed alternately at each to and fro motion of the rocking frame, the message ribbon is automatically and mechanically impelled forward. Two other spring *contact* pins, representing respectively the contact with the positive (copper) or negative (zinc) currents of the battery, are actuated by the same mechanical movement, by means of eccentric cam arrangements. Thus, when the perforated paper-ribbon is carried automatically forward step by step in rapid succession by the action of the central pin, if a "current passing" perforation is in position at the moment of passing the paper-ribbon with either pin, the corresponding pin will rise through the hole and make a metallic contact with the battery through the instrument, sending a current into the line in the one or other direction, according to the position of the perforation. When no perforation in the paper-ribbon is in position at the time of the automatic elevation of the respective pins, they fall back by the action of adjusting springs, and a *mute* movement is made by which no current from the battery is passed into the circuit. In addition to these three mechanical cam and eccentric movements in connection with the advancement of the ribbon, the elevation of the pins, and the passing of a current into the circuit from the concurrence of a perforation in the paper-ribbon, and the rising of a pin, a fourth important electrical contact movement takes place at each successive motion of the rocking cradle, independent of the rising of the pins, namely, that of momentarily making contact between the line wire and the earth after each successive elevation of either current-passing pin.

Fig. 7.



The importance of this discharge to earth to clear the line arises from the retention in the insulated line wire of a sensible portion of the transmitted current, which, unless drawn out, would interfere with the integrity of the succeeding current, reducing the transmitting speed of the wire very considerably. After each successive elevation of the pins, the circuit wire is momentarily to earth; this takes place at each motion of the rocking cradle, whether a pin enters a perforation in the paper-ribbon or not. In this mechanical arrangement, therefore, the necessary contacts with the battery and the regular discharge of the line are produced without recourse to manual labour; mistakes are avoided, as machinery never neglects its registers or makes false records, both of which errors are inseparable from the employment of the human hand and brain.

Fig. 8.

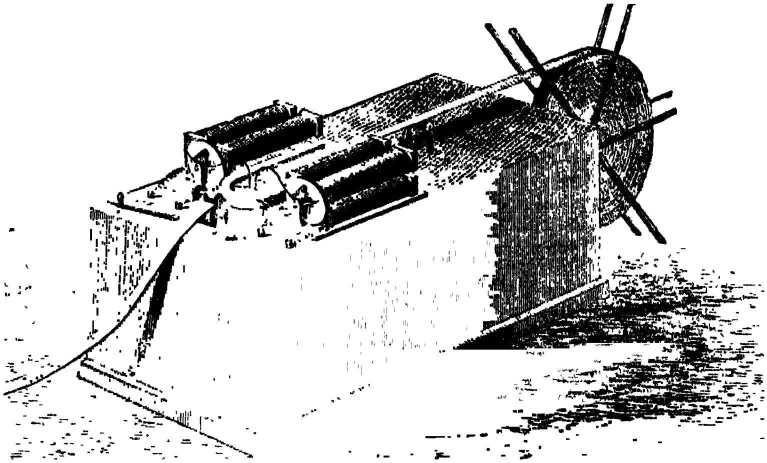


The third portion of the apparatus is the "recording" or printing apparatus, which prints or impresses legible marks on a strip of paper, corresponding in their arrangement with the apertures in the perforated paper. The pens or styles are elevated or depressed by their connectic with the moving parts of the electro-magnets. The pe are entirely independent of each other in their action, and are so arranged that when the current passes through the coils of the electro magnet in one direction, one of the pens is depressed, and when it passes in the contrary direction the other is depressed; when the currents cease, light springs restore the pens to their elevated points.

The mode of supplying the pens with ink is the follow-

ing: a reservoir about an eighth of an inch deep, and of any convenient length and breadth, is made in a piece of metal; at the bottom of this reservoir are two holes sufficiently small to prevent by capillary attraction the ink from flowing through them; the ends of the pens are placed immediately above these small apertures, which they enter, when the electro-magnets act upon them, carrying with them a sufficient charge of ink to make a legible mark on a

Fig. 9.

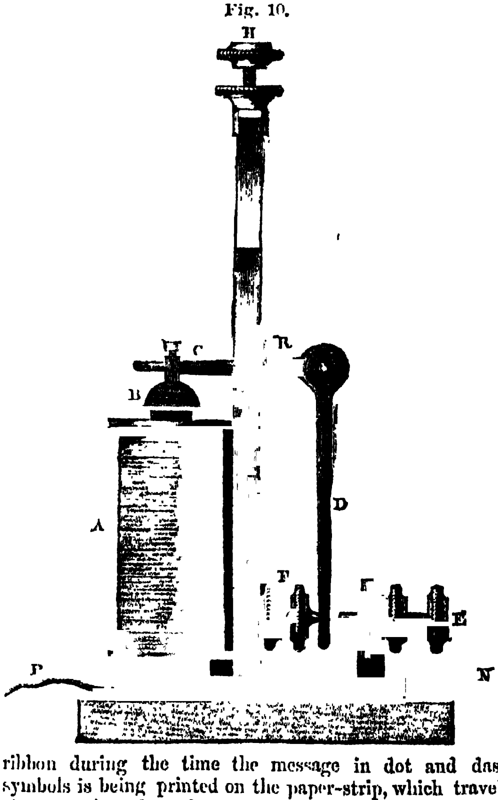


paper-ribbon passing beneath them. The motion of the paper-ribbon is produced and regulated by apparatus similar to that employed in other register and printing telegraphs. When the paper-ribbon is punched to print the "dot" and "dash" of the Morse code, it shows a row of equidistant holes in the middle, by which the paper is guided uniformly forward, and in the outer rows are holes arranged in pairs, either exactly opposite to each other or obliquely—the former produce dots at the receiving station, the latter dashes.

With such a wonderful mechanical combination of parts and high transmitting speed, it is scarcely credible that private interests interfered with the adoption of the automatic system, and that Wheatstone lost eight years of his valuable patent in vain negotiations with the Electric and International Telegraph Company. Finally successful, the revenues he received from an annual payment of a fixed sum per mile per wire amounted in the aggregate to a very large sum, increasing as the system became more and more developed. This will be readily understood when it is remembered that the Jacquard principle admits of the transmission of the message from the same prepared paper-ribbon simultaneously over several distinct circuits. The "transmitters," standing in a row, are each placed in communication with a distinct circuit; thus on one may be included Birmingham, Manchester, and Liverpool; another circuit embraces Leeds, Nottingham, Sheffield, Newcastle, Edinburgh, and Glasgow; while a third comprehends Bristol, Cardiff, Newport, Exeter, and Plymouth; and so on, the prepared ribbon passing in rapid succession through the several transmitters and simultaneously supplying the press in all these cities and towns with the message; thus, taking as an example the queen's speech at the opening of Parliament, it is circulated throughout the kingdom almost at the same moment that it is in the hands of the London press.

From among the number of printing and writing telegraphs which have been devised, the "Morse" apparatus, first brought into use in North America, is most generally employed and adopted on the Continent, and largely used by the post-office authorities in this country. In this instrument there are three distinct parts; the "receiver," the "communicator," and the "relay." The receiver (fig. 1. Plate II.) is the apparatus which, by the action of a spring or weight, carries forward continuously the paper-

Fig. 10.



ribbon during the time the message in dot and dash symbols is being printed on the paper-strip, which travels close to the edge of a vertical disc turned by clock-

work, and having its plane parallel to the length of the paper strip. The narrow edge of this disc is kept charged with printer's ink, which it receives from a roller. The extremity of the lever C connected with the armature of the electro-magnet *a a* is formed of a light strip of metal carrying the inking disc. When the current passes the disc is lifted up, and comes in contact with the paper strip, printing either a dot or a dash, according to the duration of the current. In the instrument here figured a reversal of the direction of the current is necessary to lift the disc from the paper. When, from the length of the line-wire circuit, the currents are too feeble to give distinct indications with the printing lever, an apparatus termed a "relay" (fig. 10) is employed, the use of which will be understood by reference to an instrument placed at a distant station (Glasgow), where, from defective insulation along the line wire, the current may arrive greatly reduced in energy. The currents sent from London, instead of entering the telegraph instrument direct, circulate through the coils of the electro-magnet, A, of the relay, passing out to the line wire on to the next station. In passing through the relay the soft iron armature, B, attached to the light lever, C, is attracted. This lever is kept in position by a delicate tension spring, so that it moves with very little magnetic force; the end of this lever carries an arm, D, the extremity of which works between two adjustable screws, E, F, which are electrically insulated, and regulate its motion with the greatest nicety; the one, E, being in connection with the negative (zinc) end of a battery at Glasgow, termed the local battery, by the wire N, the other positive pole of which is in communication with the lever D, the local instrument being placed in circuit. Thus, on the attraction of the armature B, the arm D completes the battery circuit through the local instrument.

The "Morse transmitting key" (fig. 2, Plate II.) consists of a brass lever, A A, working in bearings at C, and provided at the end of its longer arm with a large knob, K, of insulating material for manipulating the key by the hand of the operator. Steel pins are screwed into the insulating frame at D and N, and they are so adjusted that B is pressed against the projecting metal pin D, by the action of the spring S. When the knob K is depressed, contact is broken at B, and established at N. All four contact points are platinum-tipped, and mounted on an insulating base-board of ebonite. D and N are each provided with a binding screw for the attachment of the wires. When the key is in the position shown a current arriving by the line wire passes from the fulcrum C of the lever through the contacts B, D into the instrument. When the knob is depressed the battery current enters the lever by the contact at N, and passes into the line from the fulcrum C; thus dots and dashes are signalled at will. This form of key sends currents only from the same pole of the battery; keys by which positive and negative currents are sent alternately are called "double current" or reversing keys.

When the pole of a permanent magnet is placed within a hollow coil or helix of insulated wire freely suspended so as to oscillate on an axis, and a current of electricity is passed through the helix, it will be oscillated towards the right or left, over the poles of the magnet, according to the direction of the current. In a similar way when a permanent magnetic bar is freely suspended within a hollow coil or helix of wire, the magnetic bar will oscillate to the right or left according to the direction in which the current flows through the helix. These are fundamental laws, and it will now be pointed out how these well-known principles have been combined to produce Sir William Thomson's beautiful apparatus, the "reflecting galvanometer" and the "syphon recorder" at present employed upon submarine circuits of extended length, and by which, with very feeble currents, signals are automatically recorded at the distant station. The reflecting galvanometer (figs. 3 and 4, Plate II.) is at once the most useful and important instrument in its general applications to submarine telegraphy; its construction is exceedingly simple, the delicacy of the instrument being the result of the lightness of the moving parts. Two hollow coils of fine wire, united to form a continuous circuit, are placed one above the other, and the coils are so constructed as to admit of a very delicate axis being inserted through them free to rotate, and capable of accurate adjustment, so that the centre of rotation may be in a line with the centre of the inner ring of the coils. A minute circular concave reflector is attached to the axis concentric with the hollow centre of the upper coil. Two extremely light bar-magnets, about three-eighths of an inch in length, formed of magnetized watch-spring, are attached to the axis in the centre of each coil, one being therefore at the back of the mirror. (See fig. 4.) The poles of these bar magnets are reversed, producing an astatic combination. The whole arrangement of axis, mirror, and bar-magnets, weighing no more than $1\frac{1}{2}$ grain is suspended by a silk cocoon fibre, adjustments being obtained to insure freedom of rotation by a micrometer screw and levelling screws. The mirror is brought into the field and its motion controlled by means of a directing bar-magnet I, sliding upon a rod placed vertically on a frame B, containing the glass covering placed over the coils to protect them from currents of air; the elevation or depression of this magnet, acting by induction upon the suspended bar-magnets, gives more or less sensitiveness to the motion of the mirror when a current of electricity traverses the coils. As the eye is quite incapable of detecting with accuracy the minute angular motions of the mirror, a very simple method is employed to magnify and increase this angular motion of the magnetic bar. For this purpose a beam of light R is employed, which, falling on the mirror, is reflected back again upon a long horizontal scale placed 3 feet off, on a wooden stand in front of the galvanometer. Below the zero point of the scale, which is at its centre, a vertical slit is cut containing a fine wire drawn down the middle of the slit. A lamp is placed behind this so as to shine through the slit on the mirror of the galvanometer, which reflects back on the scale a spot of light containing the image of the wire. The instrument is adjusted so that when the needle is at rest this image is upon the zero point of the scale. A current through the coils deflects the needle and mirror, causing a slight movement of the former to be indicated by a readable deflection of the image on the scale. As the ray of light moves through an angle double that of the deflection of the needle, it is thus an indicator of about 6 feet long, that is, twice the distance between the mirror and scale. Thus the slightest angular motion of the mirror, inappreciable to the eye, is according to the length of the ray of light increased to such an extent as to indicate the presence of the most feeble currents with an almost inappreciable movement of the mirror. As this reflecting galvanometer gives no automatic register of the signals received, recourse is had to a Morse key, by means of which the recipient of the signal at once records the deflection of the light spot on the scale to the right or left in the symbolic Morse code of the "dot" and "dash."

Sir William Thomson's "syphon recorder" (see fig. 1, Plate III.), besides indicating the very feeble signals transmitted through long lengths of submarine cables, records the same upon a continuous paper-ribbon. The difficulty to be overcome in the construction of such a recording instrument has been that due to the mechanical problem of obtaining marks from a very light body in rapid motion without impeding or interfering with that motion. The essential features of the instrument may be described as follows:—A light flat coil of insulated wire, which is connected with the line wire, is suspended by a bifilar suspension between the poles of a powerful horse-shoe magnet.

When no current passes, its plane is in the right line joining the poles; when a current is passed, this coil becoming thereby a magnet, is deflected either to the right or the left, according to the direction of the current. It is exactly the reverse of the arrangement described as the reflecting galvanometer, for here the coil is movable and the magnets fixed; there the magnet is movable and the coils are fixed. A very light tube, a mere hair-like hollow filament of glass, bent in the form of a syphon, dips with its short end in a reservoir of ink, while the other end is in front of, but not touching, a paper-ribbon, which is moved along when a message is being received at a uniform rate, like the ribbon in a Morse recorder. The ink, which would not itself flow from a tube of so fine a bore, is squirted out by electrical repulsion when the insulated reservoir in which it is contained is electrified at the receiving station, and forms a mark composed of a continuous series of fine drops on the paper in a straight line so long as no current passes in the coil. This syphon is connected by a system of silk threads with the coil, and according as this is deflected either to the right or the left, the end of the syphon is deflected also, and accordingly traces a wavy line on the paper which represents deflections right or left of the central line, representative of the "dot" and "dash" of the Morse code.

Duplex telegraphy, now extensively in use over the postal telegraph circuits of the United Kingdom, admits of the transmission of messages in opposite directions at the same time on the same wire. To carry this into effect, the circuit has to be so arranged that signals formed by the depression of the key at one station shall work the receiving instrument of another station without affecting that of the sending station; and further, that the transmitting and receiving apparatus at both ends be always in circuit, so that either or both stations be in a position to send and receive. Various methods of accomplishing this object have been devised, the most practical of which may be divided into two classes: the one including those methods which are based on the principle of the Wheatstone Bridge, in which outgoing currents have no effect on the receiving instrument of the same station by placing the latter in a null branch, similarly to the bridge galvanometer, as shown in diagram form at fig. 2, Plate III. The circuit is divided at R into two branches, one going to the line, the other, through an adjustable resistance r, to earth, E. If the resistances are equal in these branches then *no* current from R will pass through the instrument M; but any current coming along the line from R′ will disturb this balance and become apparent at the receiving instrument. In like manner the instrument M′ responds only to currents from the other extremity of the line. The other system is on the principle of the differential galvanometer, in which the effects of the outgoing current on the home receiving instruments are nullified by dividing the coils of the latter into two separate circuits of equal resistance, so that the outgoing current dividing between them exercises an equal and opposite magnetic effect on the cores, as shown in fig. 3, Plate III., in which *b* is the battery and *c* the transmitting key, *m* the electro-magnet of a Morse recorder wound in reverse directions by two equal coils of wire, represented by the black and dotted lines. One of these coils is connected with the line L L′, and the other with the earth through a resistance R, adjusted to equal that of the line circuit. When a current from the key *c* reaches the point *a* it divides into two equal portions, which traverse the instrument in opposite directions, and by neutralizing each other's effects, leave it undisturbed. One of these currents goes to earth through the resistance R, while the other passes down the line L L′ to B. If the key at B is not down, the current will pass round the core of the electro-magnet *m′* in one direction only, and reach the earth through *a′c′*E′. If *c′* is depressed for the purpose of signalling, then the two opposite currents in the line may neutralize each other, but the other half of the current from *c′* will be thus left free, in passing through the coil *a′* to earth through R′, to affect the instrument B precisely as if coming from A. The "bridge" method of duplex working presents this advantage, that as the receiving instruments are placed in a null circuit, between the terminals of the connecting balance of the bridge, no special form of receiving apparatus is necessary, as is the case in the differential system. It has, on the other hand, a great disadvantage, detracting from its efficacy on long lines, viz. loss of working force, owing to the battery current being split up by means of the various derived circuits offered to its course by the bridge apparatus. The result of this is that the bridge system of duplex telegraphy requires four times the battery power used for working the same line single or simplex. Differential duplex is accomplished with two and a half times the battery power used for single working. Further development of the principles of duplex working have resulted in four currents, two one way and two another, being sent simultaneously on a single wire, while it is quite possible to send five in one direction and one in the opposite, or any other combination of six, and the speed at which messages can now be transmitted has advanced from seventeen words a minute in 1851 to 462, the present Government Post Office rate. In all instrument connections, those portions of the circuit included between the line and earth, termed "office connections," are invariably composed of covered copper wire, the insulating material employed being a specially prepared form of india-rubber known as Hooper's core, which bears exposure to high temperature better than gutta-percha or any other kind of insulating covering.

Gutta-percha not only cracks by constant exposure to heat as well as light, but becomes plastic, allowing the position of the conductor inside to shift, and its resistance decreases with rise of temperature. At any given temperature the resistance of gutta-percha is far below that of india-rubber. At 75° Fahr. the resistance of Hooper's core is sixteen times as great as that of gutta-percha; and besides possessing the advantage of higher insulation, its specific inductive capacity is lower than that of gutta-percha, an important point in considering its merits as regards use for circuits including long submarine wires, by virtue of which property retardation is reduced and speed enhanced. The specific inductive capacity of air being taken as 1, that of gutta-percha = 4·2. Hooper's core — 3·1; pure india-rubber — 2·8. Gutta-percha never perishes under water, and insulates excellently at low temperatures, its resistance increasing with pressure. The temperature of the sea below 1200 fathoms is supposed to be everywhere about 40° Fahr., the pressure of course increasing with the depth. India-rubber (pure) is liable to suffer decomposition under water, or under any circumstances whereby air is excluded, and faults in india rubber are generally extended over a considerable length; those in gutta-percha are more or less confined to a single locality.

In making joints in the insulating covering or "core" of wires used for circuits laid under water, as for submarine cables, great care and experience are necessary in order to insure the insulation of the joint being not less perfect than that of the cable at any other point.

The most important achievements in telegraphy are the great submarine lines which unite the Old and New Worlds · London with North and South America and the West Indies to the west, and with India, China, Japan, Australia and the Cape to the east; upon which circuits millions of capital have been invested.

The first practically successful submarine cable was laid between Dover and Cape Grisnez, near Calais, in 1851. This submarine line, containing four separate insulated copper conducting wires, has since then been in constant

use, with the exception of a few interruptions from accidental ruptures easily repaired. Its success immediately led to the submergence of other cables, connecting England with Ireland, Belgium, Holland, Norway, and Denmark. In 1855 the project of an Atlantic cable was entertained, and after repeated failures successfully carried out in 1866, as related in the article ATLANTIC TELEGRAPHS.

At the present time there are several Atlantic cables in successful operation connecting England and America, and France and America. In working these long submarine circuits, from the effects of induction, about three seconds are required to charge the cable, and then some seconds would elapse before the current again flowed out; about seven seconds would therefore be occupied in the transmission of a single current in the usual way. By the employment of the reflecting galvanometer about one-fourteenth of this time suffices, and the syphon recorder writes the message twelve times as fast as the Morse instrument.

TELEM'ACHOS was the son of Odusseus (Ulysses), by his queen Penelope, born only just before the king set out for the siege of Troy. That siege lasted ten years, and the hero's wanderings lasted another ten in his long and weary homeward journey, full of accident and adventure, the well-known subject of the Odyssey. Têlemachos was now twenty, and as no news came of his father he was sent forth by the queen to find him. He went first to the aged Nestor, who sent him on to other heroes, everyone receiving him most kindly, but no one being able to direct him where to find his father. After a long search he returned home, and found that Odusseus had arrived just before him. He was in time to aid his father in that extraordinary civil war in miniature, "the slaying of the suitors," princes who had been wearying Penelope with proposals of marriage during all the time of his absence.

One account makes Têlemachos marry Kirkê (Circe) when accompanying his mother to Aiaia to bury the body of Odusseus [see TELEGONOS], and of the union came Latinus, father of the Latin people. Another account gives him a daughter of Kirkê as wife.

The famous French romance of Fénélon on the subject of Télémaque is almost entirely modern in its imaginative details and general style; and while it is to some extent an imitation, it is not at all to be taken as a reproduction of the Greek myths. It is exceedingly clever, amusing, and interesting as a work in itself, but has no value as an account of Greek heroic times.

TELEOL'OGY is that part of metaphysics which deals with the "argument from design" and the final causes of things (Gr. *telos*, issue). Its main division is the endeavour to formulate a conception of God, or to prove the existence of God, from the evidences of his action as shown in creation. Paley's "Natural Theology" goes entirely upon this basis. Paley points out the wonders of the skeleton, &c., the truly marvellous way in which such a multiplex construction is adapted to its ends. Therefrom he asserts existence conscious in intelligence and benevolence on the part of the Almighty designer. In this he followed Sokrates and Aristotle. The necessity of the teleological argument so weighed upon Voltaire that he said, in his assumed mocking way, "If God had not existed he would have had to be invented."

But just as Epicurus denied the contention of the Academy, asserting and demonstrating that the operation of natural laws sufficed to produce phenomena, and that the gods were unnecessary for this purpose, so also in modern times the Darwinian hypothesis, or rather the evolutionary theory in general, has overthrown the teleology of Paley. The constant adjustment of relations between a living thing and its environment will lead to such modifications as will exactly best fit the creature for its life. If it cannot so adjust itself it dies out. Only fit creatures can live, and Paley's argument is at once superseded.

To comprehend a design one should have a mind somewhat comparable to the designer's; and this consideration should make the reverent chary of pronouncing opinions upon what they think to be the designs of the Creator.

But to show the weakness of teleology as an argument for the existence of God and a proof of his wisdom and beneficence, is by no means to deny that existence and those attributes. They are provable in other ways, and to endeavour to prove them by a weak argument is but to lay oneself open as a prey to the scoffer. On the other hand, too, the conception of a mighty lawgiver, whose laws are perfect and whose creations adjust themselves, and evermore develop and progress by virtue of those laws, is a far higher one than that of a heavenly artisan perpetually occupied in overcoming difficulties in curious and unexpectedly ingenious ways.

TELEOS'TEI is a subclass of FISHES distinguished by the completely ossified skeleton. The Teleostei, or bony fishes, are the most numerous of the fishes of the present epoch, and appeared late in the world's history, none ranging further back than the chalk. They form, as it were, a side branch of the line of descent, the higher groups of the vertebrate subkingdoms being related rather to the fishes of an older type, the sharks and ganoids. In addition to the ossified skeleton and ossified fin-rays they are distinguished from the latter fishes by the base of the aorta at its exit from the ventricle of the heart forming a mere non-contractile swelling (*aortic bulb*), by the intestine having no spiral valves, by the optic nerves simply crossing one another (*decussating*), by the tail being externally equally lobed (*homocercal*), and by the branchiæ being free. The following orders are contained in this subclass:—ACANTHOPTERYGII, ANACANTHINI, PHYSOSTOMI, LOPHOBRANCHII, and PLECTOGNATHI.

TEL'EPHONE. More than 200 years ago the natives of India were acquainted with the fact that the human voice could be conveyed some distance along an extended string. A simple experiment will demonstrate this property. Take two cylindrical tubes of thick cardboard, closing one end of each with a membrane of paper, parchment, or thin cardboard. The two vibrating discs thus formed are then connected by a string fixed in the centre of each by a knot; when the string between the two is stretched, and one of the tubes is held to the ear while another person speaks into the distant tube, all the words are transmitted by the string to the membrane of the receiver, and conversation can be maintained with a very low voice for a distance of some 600 feet. The string thus becomes the medium for a mechanical transmission of vibrations. The problem of telephony, therefore, resolves itself into the power of producing a synchronal vibration of two objects placed at a certain distance from one another, and the telephone itself is an instrument by which sounds are reproduced on the principle that *sound is the result of vibration*, and that just as the pitch of any note is dependent on the number of vibrations which take place in a given time, so also, by causing the same frequency of vibration, the identical note will be the result, the intensity or loudness of the sound being determined by the *amplitude* of the vibrations.

The first *electric* telephone was invented in 1861 by Reiss of Frankfort. It had been observed that when a current of electricity was passed through the coil of an electro-magnet, a slight sound accompanied the magnetization of the iron core. By repeating these sounds with sufficient rapidity a musical note can be obtained, and Reiss succeeded in telegraphing musical notes by interposing in the circuit of a battery and electro-magnet a vibrating membrane, which made and broke contact with each vibration imparted to it by the air. But although capable

of transmitting musical notes, even if produced by the human voice, this instrument was not able to transmit articulate speech. This was first accomplished by Professor Graham Bell in America, was patented on the 14th February, 1876 (figs. 1, 2, 3, Plate I.), and first exhibited at the Philadelphia Exhibition, where it excited almost universal incredulity: few would believe in its power of transmitting speech, and reproducing it audibly miles away in the very tones of the speaker's voice. The essential difference between Reiss's telephone and Bell's was that in the latter the electric circuit was never entirely interrupted. The complex vibrations of which speech consists were transmitted by means of variation in the strength of a continuous current acting on an electro-magnet, which in turn acted on a metallic diaphragm, and caused it to reproduce the vibrations of the transmitting diaphragm. In Bell's first instruments the current was supplied by a battery, and was only modified in strength by the vibrations of the transmitting diaphragm, to which was attached the armature of the electro-magnet. The current passing through the coil of a second similar electro-magnet reproduced the vibrations in its armature and diaphragm.

It was soon found that by using a permanent magnet, these vibrations were themselves capable of producing electric currents in the wire coil, and Professor Bell's first magnetic telephone on this principle was brought before the Essex Institute at Salem, Massachusetts, on the 12th February, 1877, when he reproduced before a large audience a speech delivered at Boston, and spoken into a perfectly identical apparatus.

Every telephone, whatever may be its construction, consists of two distinct parts: the "transmitter," which transforms the words spoken into undulatory currents, which are sent along the line; and the "receiver," which, as its name implies, receives the undulatory currents so sent, and transforms them back again into sonorous vibrations. The characteristic property of magnetic telephones is the identity of transmitter and receiver, both of which are capable of acting either part. A complete magnetic system, therefore, may consist of two instruments only, while battery telephones employ four—two for each station. In principle the magnetic telephone consists of a small electro-magnet *b* (Plate I., fig. 4), the soft iron core of which is connected with the end of a steel permanent magnet, *a a*. A thin circular disc, *c*, of soft iron is placed opposite the end of the core of the electro-magnet, being retained in position by the shoulder of a mouth-piece, so as to be capable of vibrating under the influence of any pressure of the air in the direction of the arrow; the ends of the coil wire are connected with two terminal screws *e*, *f*, attached to the ebonite or wooden case in which the instrument is inclosed. The action of the apparatus both as a transmitter and receiver of sound will now be explained, though, for reasons hereafter to be stated, its use is now almost entirely confined to *receiving*. In its position of rest the soft iron core of the electro-magnet is magnetized by induction from the permanent magnet *a a*, and itself induces magnetism in the soft iron disc *c*. Every vibration of the air caused by speaking in front of *c* is communicated to the disc itself, each movement of which, in the direction of the arrow, increases the magnetism of the core, and each return of the disc to its position of rest, by reason of its own elasticity, causes a corresponding decrease in the magnetism of the core. Now, as every alteration in the magnetism of the core of an electro-magnet is attended by a current in the coil which surrounds it, the direction of which is reversed according as the magnetism of the core is increased or diminished, its electro-motive force being proportional to the variations of magnetic force, and consequently to the variations of pressure against the disc *c*, every vibration of the disc creates a current in the coil, the strength of which is proportional to the intensity of the vibration. Thus, when the two ends of the coil *b* are connected with the terminals of another similar telephone, which then becomes the *receiving* instrument, every current produced in the coil *b*, corresponding to the vibrations of the disc *c*, is communicated to the coil of the *receiving* telephone, the currents in which react upon the magnetism of the core of the electro-magnet of the receiver, causing movements of the disc corresponding to the vibrations of the transmitting disc, which again impart vibrations to the air in front of the receiving disc, reproducing sounds similar to those which originally actuated *c*.

This instrument, though extremely sensitive as a receiver, revealing sounds which the ear, unaided, is not capable of detecting, is, owing to the feebleness of the electro-motive forces produced in the coil under the influence of the small vibrating disc, unfitted for the purposes of perfect transmission. Bell's long-distance telephone is shown at fig. 5, Plate I., in which the same letters indicate corresponding parts.

The successive transformations which take place in the inappreciable interval between the moment when the sound issues from the mouth of the speaker and the moment when it strikes the ear of the recipient are seven in number—

1. The vibration of the air sets the plate of the transmitter in motion.
2. This motion changes the magnetic division of the magnetic bar.
3. The change in the magnetic division develops induced currents in the coil of the transmitter.
4. These induced currents traverse the line and the coil of the receiver.
5. These currents produce changes in the magnetic bar of the receiver.
6. These changes of magnetism act on the plate and cause it to vibrate.
7. The vibrations of the plate are communicated to the air and strike the tympanum of the listener's ear.

The desire for an increase of power in the "transmitter" has necessitated the employment of special sending instruments termed "microphones," in which increase of electro-motive force is gained by applying a permanent galvanic current to the circuit, the resistance of which being made to vary with each vibration of the sending disc, a corresponding variation in the strength of the battery current in the coils of the receiver is effected, which thus causes the variations of the receiving telephone to correspond with those of the transmitter. The invention of the first "carbon" transmitter is due to Edison in 1876; the first microphone is due to Hughes in 1878, but the principle so applied to electrical transmission of sonorous vibrations was discovered in 1856 by Count du Moncel, who was the first to state that pressure exercised at the point of contact between two conductors touching one another, had a considerable influence on the intensity of the resulting electricity. The variation of resistance at the point of contact is the greater the more resistance is offered by the conductors; it also depends upon their degree of hardness, and upon the more or less clean state of their surface. The original form of Edison's Carbon Telephone has been greatly modified since its first introduction in 1876. Figs. 6, 7, Plate I. represent in section and elevation the form at present largely employed in France for telephonic communications. The transmitter consists of an ebonite mouthpiece, a vibrating plate *c*, and a disc of prepared carbon *a*, of the size of a shilling-piece, placed on a support *b*, which can be removed from or advanced towards the vibrating disc by a screw at the back of the frame. A small platinum plate is fixed to the inner surface of the vibrating disc, which communicates the vibrations of the disc to the carbon, the variations of pressure produced by these vibrations cause a variation

of electrical resistance in the carbon interposed between the circuit of a battery and a Bell's receiver. The carbon plate, which is the essential feature of the transmitter, is formed of lampblack from the burning of petroleum lamps with long wicks in a nearly closed space; it is afterwards condensed by light compression under a press.

The receiver of Edison's electro-chemical loud-speaking telephone is shown at figs. 8, 9, 10, Plate I. The principle upon which it is constructed will be understood from the following experiment. If a sheet of blotting-paper is soaked in a saturated solution of caustic potash, and placed on a metallic plate connected with the positive pole of a battery of two or three cells; on passing a piece of platinum foil, about one centimetre wide, over the surface of the paper, and exercising a certain degree of pressure on this foil, a resistance to the sliding motion will be felt owing to the friction of the foil against the paper, which possesses a certain roughness of surface. If, however, the platinum foil, while sliding over the paper, is connected with the negative pole of the battery, the resistance to the sliding will be diminished to a very considerable extent; the electric current has therefore the effect of smoothing or lubricating the rough surface of the paper, and this effect is proportionate to the intensity of the current; it commences and ceases with it, and is so sensitive that the feeblest currents, which are incapable of acting on an electro-magnet, are rendered quite perceptible. The fact being thus well established that an electric current of variable intensity can produce a variable sliding motion, proportionate to the intensity of the current, it becomes easy to understand the working of Edison's electro-chemical receiver. The cylinder *a* is made of a paste consisting of lime, caustic potash, and a small quantity of mercuric acetate; this paste acts the part of the paper soaked in potash in the elementary sketch. The cylinder revolves with a regular motion by means of clockwork. It is necessary that this cylinder should always remain moist, and this is effected by raising from time to time a small roller immersed in a solution of caustic potash, which is contained in a reservoir. In more recent instruments the cylinder is formed of a composition which can remain dry, a circumstance greatly simplifying the working of the receiver.

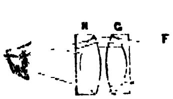
The ***microphone*** may be regarded as nothing but a telephone transmitter, an amplifying apparatus for mechanical vibrations of feeble intensity, which it transforms into undulating currents, producing sonorous vibrations of much greater intensity than the original source. The simplest form of microphone is shown in fig. 3, Plate II. It consists of two nails, A A, placed almost close together on a horizontal board. The wires X Y, attached to these nails, are connected to a battery, B, and a telephone, so that the interval between the nails forms the only break in the circuit. When a third nail, C, is placed across the two first, the current passes through the points of contact of the two nails, which form an imperfect circuit, to which circumstance the apparatus owes all its sensitiveness; and words spoken or airs sung to this little nail, which vibrates on the two others to the sounds emitted, are instantaneously transmitted to the receiver at the other end of the line with great clearness and power. With carbon pencils the effect produced is much more powerful. The most sensitive form of apparatus (fig. 4) consists of a small pencil of gas carbon, A, terminating in a point at each end; the two ends rest lightly between two small circular holes in the pieces of carbon C C′, so that the carbon pencil maintains a vertical position. The two carbon brackets, C C′, are attached to a thin sounding board, which is placed on a block of wood, D. The wires X Y, attached to the two pieces of carbon, are connected with the battery B, and the line wire leading to the telephone. This apparatus is of marvellous delicacy: a fly or other insect walking on the block D may be distinctly heard at a distance of over a mile from the transmitter. It will now be seen that the difference between Edison's carbon transmitter and the microphone are very slight; in both instruments the telephonic action is produced by variations of electrical resistance, resulting from vibrations communicated to the transmitter. In the former case these vibrations act on a plate which exercises a variable pressure on a disc; in the latter case, the vibrations effect a change in the points and the surface of contact. Plate II., fig. 5, represents in its simplest arrangement the general principle on which a microphone, M, is employed as a transmitter, with a telephone, T, as a receiver. The microphone battery B sends a permanent current through the circuit, including the line and the coils of the receiving telephone T, thus causing the disc D to be attracted to the core with a certain force, which is constant so long as the strength of the current remains the same. That portion of the microphone circuit, however, between the points L′ and E′ is so constituted that with every vibration of the disc D′ the strength of the battery current is varied. This is effected by the insertion of one or more carbon pencils, the pointed ends of which, *p*, *p*, rest loosely in sockets fixed to the back of the thin disc D′, which is made of some light resonant wood, such as deal, against which the voice or sound to be transmitted is directed, and which is concentrated upon the disc by means of a mouth-piece. Every vibration of the air in front of the disc D′ is therefore communicated to the carbon conductors, the resistance of which varies in proportion to the intensity of each vibration; which again produce a corresponding change in the strength of current in the coils of the receiving telephone, reacting upon the disc of that apparatus, and causing to vibrate the air in front of the disc D, and to reproduce the sounds which originally vibrated the transmitting disc D′. For calling attention when the telephonic apparatus is not being used, an alarm or other form of electric bell is generally placed in circuit with the telephone, and arranged in such a manner that the weight of the telephone when suspended upon a contact arm depresses the same and closes contact with the bell circuit, which is in a position to call attention when required. On removing the telephone, the bell contact is opened and the line contact is closed. For exchanging communication between two stations connected by a telegraph line, each station is fitted with the complete apparatus described.

The rapid development of the telephone since its discovery by Graham Bell in 1876 demonstrates the immense importance of his discovery; and although the instrument does not preserve a trace of the messages sent, and its rapidity in transmitting messages cannot be compared with that of the more modern telegraphic instruments, it presents the immense advantage that no previous training is necessary for its employment. It has therefore been largely introduced into public establishments, private offices, mines, submarine works, the navy, and the army; and to a large extent has superseded Wheatstone's ABC telegraph for private wire communication in the hands of the postal telegraph department. There is now scarcely a city of any importance either in Europe or America in which the telephone is not largely employed for intercommunication between subscribers to a telephonic exchange through a central station. This central office replies to the calls made by the various subscribers, and places them in correspondence, by means of a switch arrangement, with such of the other subscribers as may be desired. This arrangement, which is a very ingenious one, is represented in Plate II., fig. 6. Each subscriber being known by a number, and each wire ending in a button or knob bearing this number, the attendant at the central "exchange" may connect, by the insertion of certain pins, any two members that desire it.

TELEPH'ORUS is a genus of beetles belonging to the group MALACODERMI and family Telephoridæ. About twenty five species of this genus are found in Britain. These are the well-known "soldiers" and "sailors," the former being so called from their general reddish-yellow colour, and the latter from their bluish-black wing-cases and red legs. These beetles have an elongated, narrow, soft body, long legs, well-developed wings and wing-cases, and long antennæ; the head is not covered by the prothorax. They are abundant in meadows and pastures in summer, and are predaceous both in the perfect and larval state, preying upon other insects and their larvæ.

TEL'ESCOPE, THE, is an instrument for collecting light from a faint object sufficient to render that object visible, or an optical arrangement for magnifying the apparent size of distant objects. The former quality is usually spoken of as the space-penetrating power of a telescope, the latter as its magnifying power. An ordinary astronomical telescope consists of an object-glass at one end and an eye-piece at the other. The space-penetrating power is measured by the diameter of the object-glass, the magnifying power by the ratio of the focal length of the object-glass to the eye piece. The astronomical telescope is often used to examine objects which are invisible to the unaided eye; it is also used for the purpose of making careful observations of objects which can be seen well enough by the eye, but which require to be magnified to show details.

When we look at a distant object— for example, a star— the rays of light from that object fall in a parallel beam upon the eye, and by the optical arrangements in the eye they are brought to a focus on the retina, and there depict an image of the object. Whether we see that image or not depends upon the intensity of the light from the object which enters our eye. If the image be too faint the nerves receive no stimulus, and we do not see the object. The image can only be illuminated by the rays which pass the aperture of the pupil; the larger the pupil the more rays will be admitted, and consequently the larger the pupil the brighter the image, though the size of the image on the retina is not affected by the size of the pupil. When light is scarce, as at night, the pupil dilates with the object of grasping all it can, but it may be that, even with the pupil at its greatest aperture, the light is still too faint to produce vision. At this point the telescope renders efficient aid. When the telescope is pointed to the star a beam of rays falls on its object-glass, and after refraction through the glass they converge to a focus near the eye-piece, and then emerge from the eye-piece concentrated into a much more slender beam. Suppose, for instance, the telescope has an object-glass a foot in diameter, then the beam which falls upon that glass will have a diameter of one foot; but after passing through the telescope it will become concentrated into a beam not perhaps larger than a quill, and small enough to enter the pupil of the observer. The telescope has thus acted as a sort of funnel; it has grasped all the rays which fell on its broad surface, and poured them in through the tiny portal of the pupil. The image on the retina is now flooded with light, and the distant object is brilliantly seen. The efficiency of the telescope from this point of view depends merely upon the diameter of the object-glass; the broader the glass (of course supposing it optically perfect) the greater the power of showing faint objects. Hence it is that telescopes of large size have been constructed. We have object-glasses of one foot, of two feet, and in the case of the great Vienna refractor and one or two more, still greater diameters. But even these dimensions have been far outstripped by the great reflecting telescopes, which have culminated in the mighty reflector of Lord



Rosse at Parsonstown, which is 6 feet in diameter. The magnifying power of a telescope depends on considerations of quite a different character. The *diameter* of the object-glass or the speculum does not here concern us, but we must know its focal length. Suppose, for instance, that the focal length of the object-glass is 6 feet, and that we use with this telescope an eye-piece of one inch focal length, then the magnifying power of the telescope is seventy-two. If that power be not high enough, then we change the eye-piece for one whose focal length is half an inch, when the magnifying power is 144. The magnifying power of the telescope is thus easily changed, but its space-penetrating power, depending merely upon the object-glass, is a constant feature of the instrument.

The earliest form of telescope, and one which is still in use in opera-glasses, is known as the Galilean telescope. It consists of a pair of lenses, M N (figs. 1 and 2, Plate I.) being double convex, and P Q double concave. Let O B be an object which is supposed to be extremely far off, so that the rays coming from any point O of the object are sensibly parallel. Thus, D′ A′, D A, D″ A″, are all rays which emanate from the point O of the object. After these rays are refracted through the lens M N, they converge until at K they pass through the lens P Q, and emerge as a parallel beam K *o*. In a similar manner the rays diverging from B fall in directions parallel to B D, upon M N, and after refraction through both lenses emerge as a parallel beam at P. An eye placed behind the lens P Q will receive along the direction P *e* the rays from B, and along K *o* those from O. The divergence of these two beams is much greater than the angle subtended by O B at the eye. The ratio of these angles expresses the magnifying power of the telescope. Figs. 3, 4, 5, on the same Plate, express in a diagrammatic form the principles involved in the various forms of refracting telescopes. Fig. 3 is the ordinary form of astronomical telescope, and by following the course of the rays, A, A′, A″, and D, D′, D″ from O B, it will be understood why this telescope turns objects upside down when viewed from F. This inconvenience is remedied for terrestrial purposes by using an eye-piece of a more elaborate construction. The principle of this arrangement is shown in Fig. 5, where it will be seen that after emergence from the last of the three lenses, P Q, R S, T V, forming the eye-piece, the rays have received such a direction as restores the object to an erect position. A view of an ordinary achromatic telescope is shown in the adjoining woodcut, in which A is the achromatic object-glass, consisting of two lenses cemented together; B D E is the erector, or combination of lenses, by which the position of the resulting image at F is reversed; and G H is the compound eye-piece, through which this image is examined. C is a pencil of rays passing through the instrument.

The largest class of instruments used in astronomy are reflecting telescopes, the principles of which are shown in Plate II., which exhibits a section of the reflecting telescope as originally suggested by Newton, and as subsequently modified by Herschel. We shall first refer to figs. 1 and 2, which give the Newtonian construction. N N′ is a mirror or speculum, which is in the greatest instruments made of an alloy consisting of two parts of copper to one of tin. The smaller specula are now more usually made of glass, silvered on the exposed surface. In either case the mirror is wrought to a parabolic form, so that when a parallel beam of light O B D falls on the mirror, it is so reflected that all the rays would be brought to a focus at a single point, *o′ b′*. Before, however, the rays attain

this point, their path is intercepted by a plane mirror, H I, placed obliquely; the rays fall on this, and are thus diverted so as to form a focus at *o b*; diverging from this focus they fall on a lens, C, constituting the eye-piece, and thus enter the eye. In recent instruments a rectangular prism, H I K (fig. 2), is substituted for the plain mirror used by Newton, as it effects the reflection of the whole of the light. In Herschel's form the instrument is somewhat simplified by an inappreciable sacrifice of optical perfection. The mirror is tilted a little so that the focus of the rays is brought to the edge of the tube, and can thus be viewed directly by the eye without the necessity for a small mirror. In the Gregorian telescope the speculum A B, as shown in figs. 3 and 4, has a small perforation in the centre, in which the lens F G H, constituting the eye-piece, is inserted. A curved lens, C D, is used to receive and reflect the rays forming the image, and is so adjusted as to be a little beyond the focus T V of the mirror A B, and to form a second image, *p q*, close to the eye-piece. A similar result may be obtained by the use of a convex mirror, C D, as in fig. 1, placed nearer A B than its principal focus T V.

The noblest telescope the world has yet seen is the great reflector erected by the late Earl of Rosse at Parsonstown. In this instrument the speculum is 6 feet in diameter, and weighs over 3 tons. The tube is 60 feet long, and is mounted between two walls placed in the meridian. A certain degree of east and west movement is permitted, so that an object can generally be seen for an hour before getting out of reach by its approach to the west. As this instrument is a Newtonian, it is necessary for the observers to be placed at the eye-piece. For this purpose galleries are provided, which can be raised or lowered according as occasion requires. To work this instrument three or sometimes four men are required in addition to the observers. One man raises or lowers the instrument to the altitude at which the object is to be observed. A second winds the telescope east or west to follow the object in its diurnal motion (this is, however, sometimes effected by clockwork). A third has charge of the winding in and out of the galleries. This mighty telescope is best adapted for, and has been principally employed in, observing nebulæ, the faintness of which is so great that it requires a powerful telescope to grasp them. [See NEBULÆ.] It will be understood that for many other purposes in astronomy an instrument of much smaller calibre will be found better adapted. In particular, when exact measurements of the places of celestial bodies are sought, it is to an instrument possessing the exquisite precision of a MERIDIAN CIRCLE that we look, and not to a colossal telescope like that of Lord Rosse. See EQUATORIAL.

TELESCO'PIUM (the Telescope), a constellation of Lacaille, in the southern hemisphere, lying across the solstitial colure and between Pavo and Sagittarius. See Plate CONSTELLATIONS, Southern Hemisphere.

TEL'FORD, THOMAS, was the son of a shepherd at Westerkirk, in Eskdale, Dumfriesshire, where he was born, 9th August, 1757. He received the rudiments of education in the parish school of Westerkirk; and while engaged as a shepherd boy he made use of his leisure in studying the books furnished by his village friends. At the age of fourteen he was apprenticed to a stonemason in the town of Langholm. In 1780, being then about twenty-three, he removed to Edinburgh, where he seems to have devoted much attention both to architecture and drawing. After remaining there about two years he repaired to London, and obtained employment at Somerset House, then being erected by Sir William Chambers. He was employed upon various buildings at Portsmouth dockyard for three years subsequent to 1784; and in 1787 by Sir William Pulteney, to make some alterations at Shrewsbury Castle. He thereupon removed to Shrewsbury, where he was also engaged to erect a new gaol, and was afterwards appointed county surveyor, in which office he had to furnish plans for and superintend the construction of bridges and similar works. He erected the two bridges over the Severn at Montford and Buildwas, besides about forty smaller bridges in the same county.

The Ellesmere Canal, 103 miles long, was the first great work upon which Telford was engaged; and from 1793, when the Act of Parliament authorizing it was obtained, until 1805, when it was finished, his attention was directed almost solely to its construction. The Caledonian Canal, which was opened throughout in 1823, is another of his principal works. The locks were the largest ever constructed at that time, being 40 feet wide and from 170 to 180 feet long. Of other canals constructed wholly or partially under his superintendence it is sufficient to mention the Glasgow, Paisley, and Ardrossan (now a railway), the Macclesfield, the Birmingham and Liverpool Junction; the Gloucester and Berkeley (completed under his direction); the Birmingham, which he entirely remodelled, and adapted to the conduct of a very extensive traffic; and the Weaver navigation, in Cheshire. He also constructed a new tunnel, 2926 yards long, 16 feet high, and 14 feet wide, at Harecastle, on the Trent and Mersey Canal. His, too, were many important works connected with the drainage of the Fen country, especially of Bedford Level. On the Continent he superintended the construction of the Gotha Canal, in Sweden, a navigation of about 120 miles, of which 55 are artificial. For this work a Swedish order of knighthood and other honours were conferred upon him.

The works which he executed under the Commissioners of Highland Roads and Bridges were of great importance; and in the improvements of the great highway from London to Holyhead, under another parliamentary commission, appointed in 1815, he had a further opportunity of carrying into effect his system of road-making. The Menai Suspension Bridge especially is a noble example of his boldness in design and his practical skill.

Telford executed some important harbour works at Aberdeen and Dundee; but his most striking performance of this class was at St. Katherine Docks, London.

By his own application he acquired a competent knowledge of several languages; and he has left valuable contributions to engineering literature, in the articles "Architecture," "Bridge," "Civil Architecture," and "Inland Navigation," in Brewster's *Edinburgh Encyclopædia*. The Russian government frequently applied to him for advice respecting the construction of roads and canals; and the Emperor Alexander acknowledged his sense of his services, in 1808, by sending him a diamond ring with a suitable inscription. Although he was not connected with the Institution of Civil Engineers at its formation, he accepted their invitation in 1820 to become their president, and bequeathed £2000 to them at his death. He died 2nd September, 1834, and was buried in Westminster Abbey. See "The Life of Thomas Telford, Civil Engineer," written by himself (one vol., 4to, 1838); and also Smiles' "Lives of the Engineers."

TELL, WILLIAM, the national hero of Switzerland, was, according to tradition, born at Burglen, near Altorf, in the canton of Uri, where at the beginning of the fourteenth century he occupied a farm belonging to a convent at Zürich. The following is the usual account of the Tell legend. When Albert I. of Austria became emperor of Germany in 1298, one of his efforts was to incorporate free Switzerland with his hereditary estates, and among the cantons where he had the least right to claim supremacy were Uri, Schwyz, and Unterwalden. Into these he sent bailiffs (*vogte*), who levied taxes, exacted submission, and treated the inhabitants as if they were the subjects of Austria. To resist this tyranny the leading men of these cantons, at a meeting on the Rütli, 7th November, 1307, formed a league, at the head of which were Walter Furst

whose daughter Tell had married, Werner Stauffacher, and Arnold von Melchthal. Gessler, the bailiff of Albert I. at Kussnacht, and one of the chief oppressors of the Switzers, fixed on a pole in the market-place of Altorf a hat, to which, as a symbol of Austrian supremacy, every passer-by was ordered to make obeisance. Some days after the meeting on the Rütli, Tell refused to pay this hat the homage enjoined, on which he was seized, with his little boy who accompanied him, and brought before Gessler. Tell was a famous marksman, and to punish him Gessler placed an apple on the head of his son, and stationed the lad at a distance from his father, to whom was handed a bow and an arrow, and who was ordered to shoot at the apple on the child's head. If he missed the apple he was threatened with death. Tell procured a second arrow, and hit the apple at the first shot. Being asked by Gessler why he had a second arrow, he replied that it was meant for his oppressor if the first one had struck his child. Gessler, enraged, seized Tell, bound him, and carried him on board a boat in which he himself was sailing over the Waldstätter See (or Lake of Luzern) to his Castle of Küssnacht, in the dungeon of which he intended to immure his prisoner. On their way across the lake they were overtaken by a violent storm, and as Tell was known to be not only a skilful boatman, but familiar with the lake, his fetters were taken off and the conduct of the boat was committed to him. He guided it safely to the shore, when, seizing his bow, he leapt on to a projecting ledge of rock, still called by his name, pushed back the boat with his foot, and escaped among the mountains towards Küssnacht. A pretty little votive chapel (Tell's Chapel), on the edge of the lake, marks the spot where Tell leaped ashore. Lying in wait for Gessler in a defile through which he knew that the tyrant must pass, Tell shot him through the heart with the second arrow. The death of Gessler was the signal for an outbreak which deepened into a war that lasted for nearly two centuries, and ended in the liberation of Switzerland. Such is the legend of William Tell, as told in the histories of Tschudi and Johannes Müller, and (with embellishments) in the noble drama of Schiller. It is added that Tell was present at the battle of Morgarten, and was drowned in the year 1350, in the river Schächen, according to an account which Uhland has versified in a ballad, while endeavouring to save a child from drowning. Doubts of the truth of the legend of Tell began to be expressed early in the seventeenth century, and a controversy on the subject has been continued up to our own day. The sceptics laid great stress on the undoubted fact that a story similar to that of Tell and the apple had been told in Saxo Grammaticus and in the Icelandic sagas. The whole subject has been treated exhaustively, yet lucidly and briefly, by Dr. Ludwig Haüsser, in a work which was crowned by his university (Heidelberg, 1840). Dr. Haüsser contents himself with admitting that a person of the name of Tell existed, testimony having been borne to that fact in 1388 by 114 persons belonging to the canton of Uri who had known him. But he denies that there is the slightest historic ground for belief in any of the other items of Tell's romantic history. While the early and authentic narrators know nothing of Tell, the first mention of his exploits occurs in the chronicle of Melchior Russ, who lived and wrote so late as the second half of the fifteenth century. As to Gessler it is amply proved that no vögte of this name ever existed at Küssnacht.

TELLERS OF THE EXCHEQUER were the holders of an ancient office in the exchequer. They were four in number: their duties were to receive money payable into the exchequer on behalf of the king, to give the clerk of the pells (skins or rolls of parchment) a bill of receipt for the money, to pay all money according to the warrant of the auditor of receipts, and to make weekly and yearly books of receipts and payments for the lord treasurer. The office was abolished by Act of Parliament (4 & 5 Will. IV. c. 15), together with that of the clerk of the pells and the several offices subordinate thereto, and a comptroller-general of the receipt and issue of his Majesty's exchequer was appointed to perform the duties of the four tellers.

TELLICHER'RI (*Tallacheri*), a municipal town and seaport of British India, in the Malabar district, Madras. It is a subdivisional station, and contains the district court and jail, custom-house, churches, and many government and mercantile offices. It is a healthy and picturesque town, built upon a group of wooded hills running down to the sea, and protected by a natural breakwater of rock. The town, including the suburbs, occupies about 5 square miles, and was at one time defended by a strong mud wall. The citadel or castle, still in excellent preservation, stands to the north of the town, and is now used as a district jail. The exports consist chiefly of coffee, cardamoms, and sandal-wood. The rainfall averages about 90 inches a year; the death-rate 33 per thousand. The population is 20,000.

The East India Company established a factory at Telli cherri in 1683, to secure the pepper and cardamom trade; and on several occasions, between 1708 and 1761, the company obtained from the Kalastri or Cherakal Rajah, and other local chiefs, not only grants of land in and near Tellicherri, but some important privileges, such as the right to collect customs, administer justice, &c., within these grants.

TELLU'RIUM, a rare metal, first discovered in 1798 by Klaproth. It is found native, almost pure, in Hungary; but the principal ores are tellurides of bismuth, lead, gold, and silver. It is a frequent impurity in commercial bismuth, and its presence, even a mere trace, in medicinal salts of bismuth is very objectionable, as it imparts a most offensive odour to the breath of the patient. Although quite metallic it is classed with sulphur and selenium, the latter of which it much resembles in its chemical reactions. It is a white crystalline metal, and is usually extracted from the telluride of bismuth by fusing it with potassium carbonate. The resulting telluride of potassium is dissolved out, forming a red solution, from which, on exposure to the air, the tellurium crystallizes out. Native tellurium crystallizes in rhombohedrons. The specific gravity is 6·2; the atomic weight, 128; the symbol, Te. It is a conductor of heat and electricity. It melts at 500° C. (932° Fahr.), and at a higher temperature gives a greenish vapour. When heated in the air it burns with a bluish-green flame, and produces tellurous oxide; strong nitric acid also converts it into this oxide. It is slightly soluble in oil of vitriol, and precipitated unchanged by the addition of water. There are two oxides of tellurium, tellurous oxide (TeO_2) and telluric oxide (TeO_3), which, in combination with water, form tellurous and telluric acids. These acids combine with bases, forming tellurites and tellurates, analogous to the sulphites and sulphates. The tellurides of the metals resemble the corresponding sulphides. There are two chlorides of tellurium, the dichloride ($TeCl_2$) and the tetrachloride ($TeCl_4$); the former is a black solid substance, the latter is a dark yellow liquid. The dibromide ($TeBr_2$) is a black crystalline substance; the tetrabromide ($TeBr_4$) crystallizes in yellow needles. The di-iodide (TeI_2) and the tetra-iodide (TeI_4) are analogous compounds.

There are two sulphides of tellurium, tellurous sulphide (TeS_2) and telluric sulphide (TeS_3); both are black substances, which are chiefly remarkable for their combinations as double salts with the sulphides of the metals. These salts are called sulphotellurites and sulphotellurates. Tellurous acid or tellurous hydrate (H_2TeO_3, or H_2OTeO_2) is a bulky white precipitate, obtained by dissolving tellurium in dilute nitric acid, and pouring the solution at

once into water. It is only slightly soluble in water, but is soluble in acids and alkalies. It forms neutral and acid salts with the alkalies, called tellurites, and having the general formula M_2TeO_3 and $MHTeO_3$ respectively. The salts of the alkalies are soluble in water, but those of the metals are insoluble.

Telluric acid (H_2TeO_4, or H_2OTeO_3) is obtained from the tellurate of barium by decomposing it with sulphuric acid. It crystallizes from solution in hexagonal prisms, having the formula $H_2TeO_42H_2O$; the crystals lose the water of crystallization at 100° C. (212° Fahr.), leaving the anhydrous acid (H_2TeO_4), which is insoluble in cold water, but dissolves on boiling. It forms with the alkalies neutral and acid salts, called tellurates, and having the respective formula Me_2TeO_4 and $MHTeO_4$. These are crystalline and soluble in water. The tellurate of potassium ($K_2TeO_45H_2O$) is obtained by fusing tellurium with potassium nitrate; and from this the tellurate of barium is obtained by precipitation. Tellurium forms a gaseous compound with hydrogen, called telluride of hydrogen or telluretted hydrogen (H_2Te), and is evolved from telluride of zinc by acting on it with hydrochloric acid; it is a gas of most offensive odour, and soluble in water. The solution precipitates most of the metals from solution as tellurides. Tellurium can be detected in solution by the brown precipitate of tellurium sulphide, given by sulphydric acid, and which is soluble in sulphide of ammonium; and also by the black precipitate of metallic tellurium given by sulphurous acid. In this form it is usually estimated.

TEL'PHERAGE (Gr. *tele*, afar; *phero*, I carry). The automatic transport of goods by electrical means is the object of the system to which the name telpherage has been given. It is the invention of the late Professor Fleeming Jenkin, who unfortunately died before the first line was actually opened. A telpher line, as now constructed, consists of a strong steel wire cable, 2⅝ inches in circumference, running about 18 feet above the ground, suspended from posts about 66 feet apart; a second wire rope, 1½ inch in circumference, conveying the current.

The first actual telpher line was erected in 1885 on Lord Hampden's estate of Glynde in Sussex. (As Mr. Brand, Lord Hampden was for many years Speaker of the House of Commons.) This was constructed on Professor Jenkin's patent, with steel rods serving at once as rails and as conductor. Other details were due to the inventions of Professors Ayrton and Perry. In actual working many alterations proved to be necessary, and little by little almost all the details have gradually been changed. Even Jenkin's beautiful and ingenious "cross-over" system has given way to a simple direct circuit. The motor is connected by suitable gearing to the driving wheels of the locomotive, which is placed in the middle of the train, and pushes and hauls along the train at a speed of about 4 miles per hour. The train consists of a series of trucks or skeps evenly and somewhat widely spaced, so as to distribute the load uniformly along the suspended wire cable (see Plate). Each truck can be loaded up to any weight under 5 cwts. The train is either of the length of one span or two spans, consisting usually of a locomotive with five trucks in the first case, and a locomotive with ten trucks in the second case. This arrangement is adopted to neutralize the effect of the sag in the line on the mechanical resistance of the train. When the weights are thus uniformly distributed equal weights are simultaneously ascending and descending similar inclines in the catenary, and little more resistance is experienced than is met with in hauling a similar train along a rigid, straight road. The amount of sag or dip has extremely little influence on this resistance.

The line at Glynde is a mile in length, and is employed for the conveyance of gault clay, found on Lord Hampden's estate, to the railway, for carriage to another district of the Sussex Wolds, where it is used in the manufacture of Portland cement. Material can thus be conveyed at a cost varying from 2*d.* to 7½*d.* per ton per mile. The process supersedes the slow, expensive, and laborious practice of cartage. The cases in which telpherage is especially advantageous are those where the country is so interfered with by local obstructions that an ordinary or narrow gauge railway is inadmissible. It would, for instance, be very useful for sharp curves or steep gradients, or to carry goods across a marsh often liable to be flooded, or across a rocky mountain-pass where there are frequent chasms, or even in carrying goods and passengers across a river. It is also very cheap in construction—such a line as that at Glynde costing about £1000, all told, to put up, and about £6 a week to work, when loads amounting to 300 tons in all are carried weekly.

TEMESVAR', a fortress of Hungary, is situated between the Temes and the Bega, on the Bega Canal, about 358 miles south-east of Vienna, by the Vienna and Basiasch Railway. It has 35,000 inhabitants. It is one of the handsomest and most regular towns in the whole Austrian Empire. The inner town is surrounded by a broad *glacis*, now partly a park, and consists of large and uniform stone houses, in straight, broad, well-paved streets. Temesvar is the seat of a Roman Catholic and Greek United bishop, and also contains the court of justice for the Banat, a military academy, and a great arsenal. The most remarkable buildings are—the old strong castle of John Hunyady, used as an arsenal, the fine Gothic cathedral, the Greek cathedral, the residence of the Roman Catholic bishop, the chapter-house, the county hall in the great square, the barracks, the military and civil hospitals, the Racian town-hall, which contains the theatre and the assembly rooms. It has four suburbs. There is a considerable trade in the productions of the country, and some rather extensive establishments for tanning and leather making, as well as manufactures of woollens, oil, paper, tobacco, and wire. According to D'Anville, Temesvar is the ancient *Thybiscus* to which the poet Ovid was banished. In 1582 it was taken and sacked by the Turks, in whose possession it remained till 1718, when it was recaptured from them by Prince Eugène, almost entirely rebuilt, and strongly fortified. In 1849 it stood a siege of 107 days by the Hungarian insurgents, and was at last relieved by Haynau, but not before nearly every house had been damaged by the bombardment, and fever and cholera had made fearful havoc among the garrison.

TEM'PE was the ancient name of a valley in Thessaly, lying between Mount Olympus on the north and Mount Ossa on the south, near the mouth of the river Peneus, which runs through it. It is a narrow glen, not quite 5 miles long, opening on the east into a wide plain which extends to the Thermaic Gulf. It forms the only break in the great chain of mountains by which Thessaly is inclosed on all sides. The beauty of its scenery is much celebrated by ancient writers. In some respects it bears a striking resemblance to the Pass of Killiecrankie, in Scotland, and Dovedale, in Derbyshire, but is upon a much grander scale. It was a favourite haunt of Apollo, and the laurel he planted at Delphi grew originally in Tempê.

TEM'PERA, a former method of painting, not now used by artists, the name of which is preserved in our common distemper (water-colour mixed with very weak size), used in house-painting.

Tempera is unquestionably the most ancient method of painting. Before the perfecting of oil-painting, usually attributed to the Van Eycks, tempera was almost the only method used. It is difficult to believe that the paintings of the early masters, as for instance those in the National Gallery, are not in oil, the explanation being, however, very simple. Originally in tempera, they may now be said truly to be in oil, for repeated oil varnishings for preservative purposes have saturated them.

Painting in tempera is so named because the colours are "tempered" by a medium to a proper consistence so that they will flow from the brush. The favourite medium or vehicle in which the colours were dissolved was chiefly composed of yolk of egg, and the favourite diluent of this rather glairy and unworkable medium was the milky juice expressed from young shoots of the fig tree. The technical Italian name for this tempera was *all'uovo*. The northern artists, unable to get the fig-sap, replaced it by vinegar. It was considered better to use the egg medium when partly putrid, and the vinegar certainly was calculated to make things pleasanter for the artist. Milk, beer, wine, and various gums dissolved in water also served at various times as media; but the original egg and fig-sap dates from the time of the ancients. Pliny recommends egg and milk.

Tempera was used as wood, clay, plaster, stone parchment, and canvas by the ancients, and chiefly on wood and canvas by the moderns. The device of the ancient Egyptians, thirty or forty centuries old, of using a white ground (*gesso*) prepared with fine burnt alabaster or plaster of Paris, to paint upon was practically in invariable use with the tempera painters. Many painters of the mediæval period covered the whole *gesso* ground with thin gold leaf, on which they painted, under the delusion that the gold gave brilliancy to their colours. The great difficulty of tempera painting long remained its rapid drying, though honey and other substances were used to retard it. Fusion of tints was almost impossible. Consequently we find delicate gradations of tone indicated by means of hatching (lines) and stippling (dots).

Tempera paintings were varnished even under the Greeks. The varnish of Apellês is highly spoken of, and the painter kept it a jealous secret. The mediæval painters used amber, copal, and sandarac dissolved in oil as a varnish; and it was in all probability while searching for a better oil varnish that Van Eyck discovered the method of painting in oil.

TEM'PERAMENT, in music, is that necessary falsity of tuning by which it is made possible to play in more than one key upon the same instrument.

It is evident that in just intonation seven notes are sufficient, with an eighth to give the octave, for the production of a diatonic scale, and twelve for that of a chromatic scale. Take for instance the major scale of C: one octave length of this can be accurately represented by eight digitals. But as shown in the article INTERVAL the ratio of the Second of the scale to the prime tone (*i.e.* of D to C) is 9 : 8; and the ratio of the Third to the prime (E to C) is 5 : 4, which is the same as 10 : 8, whence we see that the ratio of the Third to the Second is 10 : 9.

But now let us wish to play in the key of D, and in this case our Second will be E, with the ratio 10 : 9, whereas it has just been shown that the ratio of a Second to a prime must be 9 : 8. This is no slight difference, but one perceptible to any accurate ear.

Again, we observe in our supposed instrument, accurately in tune in the scale of C, that while the ratio of the Fifth G to C is 3 : 2 (as is also that of the Fifths C to F and B to E), the ratio of the Fifth A to D is as 40 : 27. That is to say, in a justly intoned scale all the Fifths have the ratio 3 : 2 (or, which is the same, 81 : 54), except that from the Sixth to the Second of the scale, which has the ratio 40 : 27 (or which is the same, 80 : 54). This discrepancy between 80 and 81 is called a "comma," and is perfectly audible in such instruments as Mr. Ellis's harmonical, where both D's are shown. But this discrepancy, which is inherent in the scale and is perfectly harmonious and characteristic, prevents us altogether from playing in the scale of D upon an instrument justly tuned, for the Fifth, A to D, must have the clear ratio, 3 to 2, which we demand between the Dominant and the Tonic.

From many similar instances it results that an instrument can only be truly in tune in one key at a time, and that the slightest modulation is perceptibly faulty. Therefore, since the demand for modulation is unlimited in modern music, it is agreed to falsify every interval in the scale to such an extent that every key shall be playable, and although not strictly in tune shall be so near the truth as to be intelligible and harmonious. The charity of the ear is wide, and accepts an interval as recognizable which is many vibrations out of its true ratio. The next step is to find out how great the falsification must be.

It is evident upon trial that starting from A in the bass and proceeding by Fifths, we shall reach an A in the treble, and shall have passed through all the twelve notes of the chromatic scale in our progress. Therefore, if we so order our Fifths in this long progression of twelve that the A we arrive at in the treble is exactly seven octaves from (or, in tuner's phrase, "in unison with") the A in the bass, the thing required is done. Now by just intonation the progression of twelve Fifths is a wider interval than the progression of seven octaves, by the not unimportant ratio of 531441 : 524288, commonly called the "comma of Pythagoras," and equal as nearly as possible to a quarter of a semitone (24 cents), a trifle greater discrepancy than that of A the Fifth from D bears with A the Sixth of C, as we above said. (The latter is the "comma of Didymus," and measures 22 cents.)

What remains to be done is to flatten each Fifth in the whole series by a twelfth part of 531441 : 524288, or which is the same thing, by 2 cents. As it is the same thing whether we tune a Fifth up or a Fourth down, since the one interval is the complement of the other, the tuner is able to compress his seven octaves range of Fifths into one octave, which he calls his "bearings." [See TUNING.] A good tuner will produce a set of "bearings" almost accurately even, all the Fifths being a shade too flat, and all the major Thirds several shades too sharp for the truth. Such a set of bearings will contain twelve semitones all equal to one another; and it results from this equality that any note can serve equally well as a tonic, and all keys are equally nearly in tune. The semitone is divided into 100 cents in a very ingenious way invented by A. J. Ellis, M.S., and the difference between the scale of just intonation and that of equal temperament cannot be more vividly shown than by placing the two in juxtaposition when counted by cents. For simplicity's sake the diatonic, and not the chromatic, scale is taken, and the scale of C is written above as a guide.

Scale of Equal Temperament in Cents.

C	D	E	F	G	A	B	C
0 .	200 .	400 .	500 .	700 .	900 .	1100 .	1200

Scale of Just Intonation in Cents.

D	E	F	G	A	B	
204 .	386 .	498 .	702 .	884 .	1088	1200

It would at first sight seem impossible that the one scale should serve as a makeshift for the other, but long habit and the charity of the ear already referred to have accustomed us to the approximation. Still truth is truth, and the exquisite purity of the chords of a fine quartet of voices or of violins, which makes those combinations the highest expression of harmonized music, is largely due to the absence of temperament except when in the very act of modulation.

Equal temperament is now practically universal. It was John Sebastian Bach who first insisted upon its necessity, and proved it practically by playing in extreme keys with excruciating effect until he convinced his hearers of his point. He was too bold a modulator to consent to be "cabined, cribbed, confined" to a few keys. The older temperaments, however, took the latter course. The old "mean-tone" temperament, by using flatter Fifths than

equal temperament, obtained perfect major Thirds in several keys, but anything with more than three flats or three sharps in the signature was unplayable; all the extreme keys were entirely sacrificed.

Other systems demand more than twelve tones to the octave. The best of these enlarged systems is that with 118 tones to the octave, which is not practically distinguishable from just intonation. That is to say, if an organ could be made with 118 accurately tuned tones to the octave this would yield material for all the twelve keys. But since the twelve keys only demand at the outside 144, the saving does not appear so great as it might be. Consequently there is another system with fifty-three tones to the octave which is preferred by enthusiasts on the subject: and at South Kensington, in an exhibition of musical instruments in 1872, a harmonium was shown with eighty-four keys arranged in seven rows and giving fifty three separate tones (with thirty-one duplicates), all the huge instrument playing only one octave. The keys were arranged in seven rows, and by the help of the duplicates it was easy to play a scale in any key with identical fingering. Any one who saw this instrument, however, must have at once admitted that it was a mere philosophical toy. Equal temperament is a necessity of the age, and it has as yet proved impossible to overcome its deficiencies.

TEM'PERAMENTS, THE FOUR, are an ancient division of mankind by external appearance, the value of which lies in the assumption that mental qualities are in some sort indicated by them. So greatly did this assumption seem to be warranted that Hippokratês, the father of medicine, propounded the classification which is the subject of this article, four centuries before Christ. And after essays at divining the character through physiognomy, phrenology, and the like, the doctrine of temperaments still affords the likeliest guess at a man's mind, following the indications of his bodily appearance.

First, however, the meaning of the word must be restored. Like many other words, temperament has suffered from age, and it is quite usual to hear the phrase, "one of his temperament" (meaning sometimes "idiosyncrasy" and sometimes "character"), and to meet with the expressions "poetic temperament," "positive temperament," and the like. Dean Stanley strove, says his biographer, "with all the energy of an eager temperament, for the cause of religion." But the word in its original signification related to definite colours and forms of the human body, and there is no valid reason for its misuse.

It is a great pity that the study of the temperaments, which formed so large a part of the ancient medicine, has fallen until lately into disuse. Freed from the barbarous and hypothetical jargon with which it was formerly clogged, it forms a most interesting and important branch of the science of man. Its indications are useful as announcing tendencies of character and probable habits of mind, the nature and objects of moral affections, and the predisposition to particular diseases, alike interesting to the student of character and to the physician. In fact, as Maudsley very truly says ("Pathology of Mind," 1879), every experienced man of the world does in fact form a rapid judgment from temperament as to each person that comes before him, and accuracy in detecting mixtures of temperament and allowing for them forms a large part of the almost marvellous power we call tact, which the man who possesses is the least able to explain. As Addison shrewdly remarks in the *Spectator* (No. 86), "I think we may be better known by our looks than by our words."

The four temperaments of Hippokratês were the Sanguine, the Bilious, the Melancholic (or atrabilious), and the Lymphatic, denoted outwardly by the colour of the hair, the eyes, and the complexion; and assumed to arise, in the old views of medicine, from a preponderance of blood, of yellow bile, of black bile, and of lymph respectively. Since we no longer believe in black bile, and since the melancholic temperament is largely nervous, modern inquiries substitute nervous for melancholic, still keeping the number four. The Bilious temperament is by some writers called Choleric, (an identical term), and the Lymphatic is also called Phlegmatic. The four temperaments are, therefore, ruled physically by the heart, the liver, the lymphatic system (and tissues generally), and the brain respectively.

The physical characteristics of temperament besides the colour of the hair, of the eyes, and of the complexion, are the form of the nose, the contour of the face, the length and thickness of the neck, and the general build of the body. Now, these latter characteristics (of form) at once mark off the Nervous temperament from the other three, for the Nervous possesses a tapering face, a narrow nose, a long neck, and slim built body, while the Sanguine, the Bilious, and the Lymphatic have a square face, an outspread nose, a short neck, and a thick-set body. The truth of this is manifest to any one who will consider the large number of portraits of famous imaginative men as compared with an equally large number of those whose fame rests upon material works. We might compare Reynolds with Hogarth, and Addison with Steele, for example. But such an investigation will reveal the further fact that the temperaments are rarely found pure, although one of them may and often does so largely preponderate as to sway the character. Nevertheless, as the four pure temperaments are the necessary basis of the whole study, they shall now be given as formulated by their latest and most accurate observer, Alexander Stewart ("Temperaments," London, 1887).

Sanguine Temperament.—Physical side: reddish hair, blue eyes, florid complexion, square face, outspread nose, short neck, and thick-set build. Mental side: impulsive, readily provoked and easily reconciled, ardent but not persistent, fond of muscular rather than mental pleasures, and of pursuit rather than enjoyment, happy with small things, outspoken, not minutely informed.

Bilious Temperament.—Physical side: black hair, dark brown or black eyes, pale olive complexion, square face, outspread nose, short neck, thick-set build (as in the Sanguine temperament). Mental side: not impulsive, wary in business, passionate and revengeful, eager and persistent, fond of business pursuits rather than muscular or mental pleasures, but able to excel in all, happy with large aims, decided in speech and well informed.

Lymphatic Temperament. Physical side: flaxen hair, often thin, light hazel, greenish or brownish grey eyes, often lustreless, colourless opaque complexion, square face, outspread nose, short neck, thick-set build (as in the Sanguine temperament). Mental side: slow of thought, conclusions carefully arrived at, not readily provoked but not easily reconciled, persistent but not ardent, plodding in business, not fond of muscular pursuits, happy in "creature comforts," slow in speech, often well informed.

Nervous Temperament.—Physical side: light brown hair, gray eyes, pale clear complexion, face a tapering oval, from a broad or high forehead to a narrow chin, narrow nose, long neck, slight build, never corpulent but often tall and extremely thin. Mental side: impulsive and animated, over rapid in conclusions, readily provoked and immediately reconciled, imaginative and fastidious, persistent in work even to overtaxing the strength, fond especially of intellectual but also of muscular pursuits, happy in the higher pleasures of the senses, fine art, literature, rapid in speech, not precise.

Here we see that the first three temperaments are physically powerful, whilst the Nervous indicates rather a gentle, imaginative, and intellectual disposition. There is no doubt also that the latter is rapidly increasing with the growth of education, and in many ways the change is calculated to cause anxiety. Our great grandfathers, if

they could be brought from their graves, would have to be told what we mean by nervousness, and the Greeks had no words to express such a thing. Though nervousness is not to be confused with the Nervous temperament, it too often results from the physical bankruptcy which that eager character brings on when unchecked by more prudent elements. Brain trouble in one form or another haunts the Nervous temperament, as the hard fates of our men of genius tell us too plainly, and as lesser folk know in their own degree. The telegraph, the cheap post, the express train, and the enormously increased hurry of business are dire foes to the man of Nervous temperament. Nervous diseases scarcely exist among muscle-workers as distinguished from brain-workers. Therefore the brain-worker of Nervous temperament carefully should cultivate a habit of walking or gardening, or pursue some outdoor game, while in the long winter evenings billiards or gymnastics in strict moderation, or some other indoor game involving exercise, should be chosen for recreation. Dickens invariably walked precisely as many hours as he had written. [See the remarkable paper of Addison on the subject, *Spectator*, No. 115, written at a time when very few men had a thought about such things.] Some literary men take to turning and carving for this reason: many prefer the tricycle (Lord Sherbrooke, for instance); some, as Mr. Gladstone, fell trees.

This brings us to the last consideration allowed by the limits of our space—the *mixture of temperaments*. The question arises, how is it possible for a specimen of the Nervous temperament, such as Mr Gladstone is, to enjoy such phenomenal vigour and length of life? His broad forehead, light, thin hair, moderately tapering face, and pale complexion are, however, joined to a short neck and a thick-set trunk, and in body as well as mind Mr Gladstone is happily almost as Sanguine as he is Nervous, and nervousness is successfully kept at bay. Lord Beaconsfield, whose face was oval and his nose thin, but whose forehead was high rather than broad, while his hair and eyes were black, and his complexion unmistakably bilious, was saved by these preponderating Bilious elements from the danger indicated by the markedly Nervous signs. These mixed temperaments produce the best result. Suppose a Sanguine temperament with black eyes (a Bilious sign); here we should still regard the temperament as (altered) Sanguine. But suppose the altering signs were an oval face, long neck, and a thin body, three markedly Nervous characteristics, the result would be a Nervous-Sanguine temperament, with a corresponding mixture of mental characteristics. We see in the very greatest men some such mixtures. Mozart and Mendelssohn, almost purely Nervous, died early, but Handel with several Lymphatic, and Beethoven with equally strong Bilious ones, endured and worked through fairly long lives. Raffaelle and Michelangelo will serve also to show the greater endurance of the Nervous-Bilious as against the purely Nervous temperament. The equally balanced temperament is what one would choose if one had the power; when the excellent heart and impulsiveness of the Sanguine is tempered by the slow deliberation of the Lymphatic, and the eye-to-business qualities and love of power of the Bilious are ennobled by the imaginativeness of the Nervous; the indecision of the Nervous when all sides of a question are rapidly passed in review would be overcome by the necessity for rapid judgment which is felt by the Sanguine, and the love of "creature comforts" which marks the Lymphatic would be checked by the "vaulting ambition" which belongs to the Bilious.

TEMPERANCE MOVEMENT. For the earliest beginnings of this important movement we must look to the United States of America, where during the opening years of the present century the extraordinary prevalence of the vice of drunkenness called for stringent measures of reform. As far back as the middle of the seventeenth century laws were passed in some of the New England colonies to restrain intemperate drinking, and numerous efforts towards the same end were subsequently made by ministers and philanthropists; but the first modern temperance society is believed to be one that was established in April, 1808, at Moreau, Saratoga county, New York, by Dr. B. J. Clarke. This society inflicted a fine of 25 cents on any member who drank spirits or wine except during illness or at public dinners, 25 cents for offering drink to others, and 50 cents for being intoxicated, and though its influence was but local, it lasted until 1822. During this period several other societies were formed, but the first to attract general attention was the American Society for the Promotion of Temperance, which was organized in Boston, 13th February, 1826. Dr. Justin Edwards became the corresponding secretary of this society in 1829, and in addition to his pamphlets on the subject of intemperance, which attracted widespread notice, he travelled extensively about the country preaching temperance and organizing state and local societies. In 1829 the New York State Temperance Society commenced its career, and soon after this period the number of societies established in the United States were reckoned at 1000, and the number of members at 100,000. From the New World the influence of the movement spread to the Old, and in August, 1829, a society was formed at New Ross, in Wexford, and another at Belfast. During the same year the number of societies in Ireland rose to sixty, with about 3500 members, and in the month of October the first Scottish society was organized at Greenock by Mr. John Dunlop. In November, 1829, the Glasgow and West of Scotland Temperance Society was established, and its labours were carried on with such energy that by 1830 it numbered over 5000 members, and had put into circulation over 400,000 temperance tracts and pamphlets. Up to this period the efforts of both the American and British societies had been chiefly directed against the use of ardent spirits—wine, cider, and malt liquors being permitted to the members in moderation, and it was not until the futility of this compromise became apparent that total abstinence from alcohol was insisted on. The first *total* abstinence societies are supposed to have arisen about 1830, the first English association with this object being started by Joseph Livesey and others at Preston, Lancashire, in 1832.

The word "teetotal" came into use in the following year. It is said that a plasterer's labourer, named Richard Turner, was accustomed to stutter out in Lancashire dialect his hatred of the "moderate" doctrine: "I'll hev nowt to do with wi' this moderation—botheration—pledge; I'll be reet down tee-tee-total for ever and ever." The "tee-tee-total" was accepted by abstainers as the shibboleth of their creed. It is but fair to add that some authorities ascribe a different derivation to the phrase, which they state is in common use in the county palatine as a synonym for thorough; when a man is discharged from inability to work, he is said to be *teetotally sacked*. At all events "teetotalism" made an extraordinarily rapid progress, and an active warfare arose between its professors on the one hand, and the more moderate advocates of temperance on the other.

The balance was decided in favour of the former, it seems to us, by the energy and eloquence of Father Mathew, who commenced his labours at Cork in 1838, and in five months administered the teetotal pledge in Ireland to 131,000 persons. Travelling round the island he increased the number to upwards of 1,500,000, and when he visited England and Scotland his success was not less distinguished. He gave so great an impetus to the movement that he may fairly be called the apostle of teetotalism. It is true that even before his death something of the excessive fervour of his disciples had declined, and thousands of pledged

abstainers had "relapsed;" but no impartial observer will deny that he effected a marked improvement in the morals of the lower classes.

In 1846 The World's Temperance Convention met in London, on which occasion 302 delegates represented different societies in Great Britain, Ireland, and the United States. Since that period the cause of temperance has progressed in a manner which no moralist can fail to rejoice at. Associations are formed and flourishing not only in our great cities, but in our small rural towns, and the young have been enlisted in the movement by the establishment of Bands of Hope. Their principles are advocated by magazines and weekly journals, lectures, public and private meetings, demonstrations, and prize novels and essays. It is affirmed that, at the present time, the United Kingdom can boast of 3,000,000 pledged total abstainers.

One of the most prominent features of teetotalism in the present day, is the establishment in this country of the Independent Order of Good Templars. This organization originated in the year 1851 in Central New York, and in a few years spread over the United States and British North America. In the year 1868 the first "Lodge" in England was formed at Birmingham by Mr. Joseph Malins, and the order was within a year or two firmly established in Scotland, Ireland, and Wales. Since then missionary delegates from the Grand Lodge of England have established branches of the order in the colonies and many foreign countries. In 1876 a split occurred between the lodges of England and those of the United States, on the question of the admission of coloured people, and the order has since been divided into two nearly equal sections, having their headquarters in England and America respectively.

The objects of the order are to secure universal abstinence from intoxicating beverages, and the total prohibition of their manufacture and sale. The adherents of the order maintain that the use of intoxicants is unnatural and injurious, and that licensing their sale is an immoral act, seeing that intemperance increases in proportion to the facilities afforded for obtaining such drinks. Every candidate for membership must give a solemn pledge of total abstinence from all intoxicating drink, together with a promise not to furnish intoxicants to others, and to do all in his power to promote the cause of temperance; another clause in the obligation being, that he will not only take no part in knowingly injuring a fellow-member, but will, if he is in distress, grant him such assistance as will enable him to tide over his difficulties. In this respect the order is identical with the principles of freemasonry, which seek to bind man to his fellow-man with ties of love and gratitude. The Good Templars also resemble the Freemasons in their enrolment into Lodges, their subscriptions, an air of mystery about "initiations," signs, passwords, and a weakness for numerous officers and gay insignia.

Among other important organizations connected with the temperance movement is the United Kingdom Temperance Provident Institution, a life insurance society founded in 1849 by Mr. R. Warner, whose life had been refused at the ordinary rate by an insurance company on account of his teetotalism. Only total abstainers were insured at first, but soon after its foundation the society opened a general section, and it has ever since received both abstainers and non-abstainers, though the receipts and expenditure of each are kept entirely distinct, and each section shares its own profits. The experience of the society, which has now an income of over £420,000, and an accumulated fund of over £3,600,000 is decidedly in favour of total abstinence as a means of prolonging life. Determined to carry out the principle of total abstinence to the fullest extent, Temperance Hospitals have also been founded and maintained by teetotallers for the non-alcoholic treatment of disease, and the experiment upon the whole has proved singularly successful.

Of late years the advocates of temperance and teetotalism, not contented with social and literary propagandism, have endeavoured to enforce their principles by means of legislative action. In the state of Maine, in America, the liquor traffic was suppressed in 1846, and in 1851 a law for the suppression of tippling shops, &c., rendered penal the sale of intoxicating drinks. It has, however, been proved on incontrovertible evidence that these measures have rather tended to encourage than diminish intemperance, and that evasions of the law on a scale of enormous magnitude have demoralized public feeling and thrown open the door to scandalous abuses. The advocates of legislative prohibition in the United Kingdom have, therefore, felt that to agitate for a Maine liquor law would be a hopeless task, and have laboured to obtain what they call a Permissive Bill, now modified into a Local Option Bill, by which a majority of the ratepayers in a parish may be at liberty to suppress the sale of liquor in that parish. To such an enactment the same objections would apply as to a Maine liquor law. It would be equally a violation of all rules of political economy, would be equally unsuccessful, and would just as certainly promote an illegal and unlicensed traffic. We must look for the suppression of intemperance to the gradual spread of education, to measures of sanitary reform, and to the slow but steady progress of public opinion.

There is no doubt that in the United Kingdom a very large proportion of the consumption of alcoholic liquor is due to the fact of this kind of drink being more procurable than any other. Until the drinking fountain movement, such a thing as a draught of water for the wayfarer was almost impossible, and even now it is not so accessible as it should be; while, for those who did not care for water, the only alternative was, until recently, the ale-house. Somewhat tardily there has been recognized the fact, that one of the chief needs of the day is a number of cheerful, wholesome, well-conducted houses, where non-alcoholic refreshment can, not merely be obtained, but enjoyed, and offering to business people and friends the same opportunities of free and easy meeting and intercourse as the public-house provides. It is to supply this need that there have sprung up of late years numerous cafés, coffee-taverns, coffee-palaces, coffee and chocolate houses and rooms, coffee public-houses, and other similar establishments.

Besides London, Liverpool, Manchester, Dublin, and some other large towns, several of the less populous provincial towns have adopted the temperance refreshment-house movement, and there is a Coffee Public-house Association, the object of which is, not so much to start houses of its own, as to promote their establishment in London and the country generally. They are sometimes the outcome of private enterprise, as in the case of Mr. Lockhart, whose Cocoa Rooms are so well known in London and the northern towns of England; but, generally speaking, temperance refreshment-houses are promoted by public companies.

With respect to the arguments in favour of total abstinence, it may be said, briefly, that they are chiefly based upon religious, social, and physiological grounds. Under the first head the advocates of total abstinence appeal to the necessity for temperance and self restraint upon all who accept the claims of religion, and chiefly upon the duty of self-denial for the sake of others, or as it has been personally and tersely put, "if you are fond of alcohol you ought to abstain for your own sake; if not, you ought to abstain for the sake of others." The social pleas are based upon the enormous injury inflicted upon society by intemperance, and unhappily the cruelty, selfishness, pauperism, and crime caused by the drinking habits of the present day afford an absolutely inexhaustible fund of illustration and argument in support of this side of the question. Finally, it is contended that alcohol in any form is always

unnecessary, and in nearly every case injurious in its action upon the body. This view has received much important medical testimony in its support, but on the other hand the weight of evidence taken up to the present seems rather in favour of those who contend that alcohol in small quantities may be taken with advantage by most constitutions. The quantity admitted as beneficial, however, is much less than what most persons consider a moderate allowance, and all authorities are agreed that given a pure atmosphere, sufficient exercise, and wholesome food, stimulants form a quite unnecessary adjunct to diet. See also INTEMPERANCE.

TEMPERATURE. Before the difference of temperature on the same parallel of latitude in the old and new continents was known or regarded, a simple formula was thought sufficient to express the temperature at any parallel of terrestrial latitude. In 1819 M. Daubuisson ("Traité de Géognosie") proposed, for this purpose, the formula $t = 32° + 49° \cos^2 L$, in which t denotes the mean temperature (Fahrenheit) at the place, and L its geographical latitude; the mean temperature at the equator being considered as 81°. This formula has been found to serve for temperatures in Europe as far north as the latitude of 60°; but beyond that parallel it is useless, as it supposes the temperature at the geographical pole to be 32°, which is much too high.

From above 4000 observations which were made by Sir Edward Parry, it is found that in Winter Harbour, in 74° 45′ N. lat., and in lon. 250° (110° W. lon.), the mean temperature is as low as 1·33°; and from above 600 observations at Spitzbergen (78° N. lat.), Mr. Scoresby found the mean temperature to be 16·99°. A mean temperature of 17° is also found on the American continent in 65° N. lat.; and hence it may be inferred that, between the parallels of 65° and 78°, and near the meridian of Winter Island, there exists a pole of minimum temperature. The mean temperatures of places in the eastern parts of Asia have not been well ascertained; but since at North Cape in Lapland the mean temperature is that of freezing water, and in North Siberia the ground is constantly frozen to a depth of 700 feet, it is evident that the isothermal lines must form a curve about some point as a focus in the northern part of the Asiatic continent. See ISOTHERMAL LINES and HEAT OF THE EARTH.

This circumstance suggested to the late Sir David Brewster the formula $t = (T - \tau) \sin^n \delta \sin^n \delta' + \tau$ for the mean temperature at any place; t being that temperature, T the mean temperature at the equator, τ the temperature at each of the foci of coldness, and δ, δ', the distances in degrees between the given place and those foci. A corresponding expression will serve to determine the number of vibrations which would be performed by a magnetized needle in a given time if T and τ be made to represent the numbers performed, in an equal time, at the magnetic equator, and at either of the poles of magnetic intensity; the exponent, n, both for temperature and intensity, is to be determined by means of observations, and Brewster considered that the fraction $\frac{3}{2}$ may be the value of it in the formula for temperature.

It is generally believed that the temperature of the western parts of Europe is now higher than it was nearly 2000 years since; and it has hence been inferred that the poles of minimum temperature perform revolutions about the geographical pole of the earth. Recent observations have shown that the mean temperature of the year at Greenwich is 2 degrees higher, and that of the month of January 5 degrees higher, than it was 100 years ago.

TEMPLARS or **KNIGHTS TEMPLARS** are the popular designations for the Brethren of the Temple at Jerusalem, also called the Soldiers of the Temple (Lat. *milites templi*) and the Soldiers of Christ. The three great religious military orders of mediæval Christendom, the Knights of the Hospital of St. John of Jerusalem (commonly known as the Knights Hospitallers), the Templars, and the Teutonic Knights of St. Mary of Jerusalem (or German Knights of the Cross), all originated in the twelfth century, and of these the Templars were the most celebrated and powerful. The founders of the Order of the Templars were two French knights, Hugues des Païens and Geoffroi de Saint Adhémar or Saint Omer, who, in 1117 took upon themselves the obligation of escorting the pilgrims who continually journeyed between Jerusalem and the river Jordan. They were soon joined by seven other knights, and were permitted by the patriarch of Jerusalem to add to the three usual monastic vows a fourth, binding them to defend the holy sepulchre and to protect pilgrims travelling through Palestine. They were also generously befriended and encouraged in the beginning by the Knights Hospitallers of St. John. They were very poor, being called at the outset "the poor soldiers of the Holy City," and the two founders, in their first excursions, rode upon one horse, a fact perpetuated on the great seal of the order. Baldwin II., king of Jerusalem, gave them a lodging in his palace near the traditional site of the temple; to which the abbot and canons of the church and convent of the temple, which stood adjoining, added another building for keeping their arms, whence they acquired the name of Templars.

Their number was not allowed to increase beyond nine till the council of Troyes, 1127–28, which Hugues des Païens and five of his brethren attended, and which commissioned St. Bernard of Clairvaux to draw up a rule for them, and devise a habit suitable to their mode of life. This rule, approved by Pope Honorius II. in 1128, is divided into seventy-two articles, several additions having been subsequently made. It bound the knights to be present when it was possible, at the public canonical office, and when absent on military service to recite certain vocal prayers at the stated hours. They were to abstain from flesh meat four days in the week, and to refrain from hunting and hawking. Their oath, on making their religious profession, bound them to defend, at the peril of their lives, the mysteries of the Christian faith, the seven sacraments, the fourteen articles of belief, the Apostles' and Athanasian creeds, the Scriptures with the interpretation approved by the church, the doctrine of the Trinity, of the perpetual virginity of the mother of Christ; to perform military service beyond the sea whenever called upon to do so; and never to fly before three infidels, even when alone. The knights were given a white tunic and mantle to distinguish them from the Hospitallers, who were arrayed in a black mantle, and they wore this plain until Eugenius III., in 1146, appointed them to wear a red cross on the left breast, in imitation of the white cross worn by the Hospitallers. Their banner was of white linen striped with black, and was thence called *beauséant*, the name given at the time to a horse marked with black and white, and this word subsequently became the famous battle shout of the templar chivalry. The red cross was added to the banner in 1166. The helmets of the knights, in token of humility, had no crest, and their beards were uncut.

After the council of Troyes, Hugues des Païens, with several of his companions, travelled to the different courts of Europe to enlist recruits for the order, and such was his success that he was enabled to return to the East at the head of a band of 300 knights. Appealing as it did to the two strongest passions of the time, the desire for military fame and for the sanctity of the monastic life, the new order rose rapidly in dignity and importance, members of the noblest families in every nation of Christendom eagerly sought to be joined to it, and the little band of nine soon grew into as many thousands. St. Bernard, whom the Templars always designated as their "father," addressed them in 1146, at the prayer of Hugues des Païens, a series

of exhortations in which he defined their duties and the virtues peculiar to their profession. It is significant, however, that while he speaks with approval of their services to the church and their extraordinary increase, he mentions incidentally that "the greater number of the nobles who have joined the Soldiers of the Temple, have been men stained by every species of crime, whose conversion had the twofold effect of ridding Europe of oppressors and scourges, and of giving defenders to Palestine." Soon the order became wealthy as well as powerful, legacies and donations in lands and money were showered upon it, and in course of time it acquired ample possessions in nearly every country in Europe. As it increased, the original and simple constitution drawn up by St. Bernard gradually became obsolete, and between 1217–66 the whole rules were revised and promulgated anew in an improved form. According to these later rules the members of the order were divided into three classes:—1. The knights, who were all men of noble family. 2. The serving brothers, who were drawn from the citizen class, and who were subdivided into *armigeri* or brothers-in-arms, who fought, voted, and were eligible for some of the lower offices of the order, and *famuli* or servants, who were craftsmen and performers of menial duties. 3. The *affiliati* or *oblati*, men who attached themselves to the Templars and gave support to them without being bound by their vows, in order to share in their manifold privileges. 4. A small number of priests, who acted as chaplains, secretaries, and preceptors, but who were not bound by the military vow, and who were not eligible to the higher offices. At the head of the order was the Master, or Grand Master, who was, however, not only elected by the Chapter, or general body of the knights, but was also very much controlled by that body. He held the rank of a prince, and had immediately under him his seneschal, or lieutenant; the other high officers being the marshal, the grand preceptor, the draperer, the turkopolier, and the general visitant—all of whom, with the exception of the last, were elected for life by the knights in general chapter.

The several countries in Asia and Europe in which the order had possessions, were denominated provinces; and each of them was presided over by a resident chief, called indifferently a grand prior, grand preceptor, or provincial master. Under the provincial masters were the priors, otherwise called bailiffs or masters, who had each charge of one of the districts into which the province was divided; and, finally, under the priors were the preceptors, each of whom presided over a single house of the order (or sometimes over two or three adjoining houses which were considered as one establishment), hence called a preceptory. The head province was that of Jerusalem; and in this province the grand master resided so long as the Christians retained any footing in the country; first in the city of Jerusalem, from the origin of the order until 1187, when the city was taken by Saladin, and the kingdom founded by Godfrey of Bouillon put an end to; then at Antioch until 1191; at Acre, from 1191 to 1217; then at a huge feudal castle which they had built in a pass through the mountains near Acre, called Pilgrims' Castle, till 1291, when the Latin power was finally extinguished in Palestine. On this the knights removed to the island of Cyprus, which they had purchased from Richard I. of England for 35,000 silver merks, and this remained their headquarters until the destruction of the order. In the East, besides the province of Jerusalem, the order possessed thereof Tripoli and Antioch; in the West were the provinces of France, Auvergne, Normandy, Aquitaine, Poitou, Provence, England (including Ireland and Scotland), Germany, Upper and Central Italy, Apulia, Sicily, Portugal, Castile, Leon, and Aragon. The French provinces were by far the most important, and gave to the order the great majority of its members, as well as its wealthiest possessions. So rapidly had these accumulated throughout Christendom, that Matthew Paris affirms that, in the middle of the thirteenth century, they held 9000 manors.

The order from the first was patronized and protected by the popes, and by their favour it came in course of time to be designated as sovereign, the grand master owing no allegiance to any prince, and being solely dependent on the Pope in spiritual matters. Their houses were privileged, the ordinaries having no jurisdiction over them; their churches and cemeteries were not liable to interdicts, a privilege of immense value in that period; their properties and revenues were exempted from tithes and taxation; no person who had made profession as a Templar was allowed to leave the order, unless he entered another of stricter observance; and no prelate or prince might put a Templar on his oath, or call on him for any feudal service. Popular as they had been at the beginning, these extraordinary privileges, and their growing wealth and power, caused them after a time to be regarded with jealousy and dislike both by the clergy and the governments. To the popes they were always faithful, and stood by them in all their quarrels; while for more than 170 years the Soldiers of the Temple formed the most renowned portion of the Christian troops engaged in the East, and almost every encounter with the enemy bore testimony to their prowess and daring. After their fall they were charged with impiety and profligacy, but contemporary monastic writers, during the period of their prime, seldom if ever accuse them of these crimes, though there are numerous complaints of their pride, haughtiness, and overbearing ways. At the same time all testimony is united concerning the desperate courage of the order, and braver and more resolute fighters have perhaps never been seen than the soldiery of the temple at Jerusalem. Towards the close of the thirteenth century dangers began to thicken around the order, and the opening years of the fourteenth century witnessed its complete destruction.

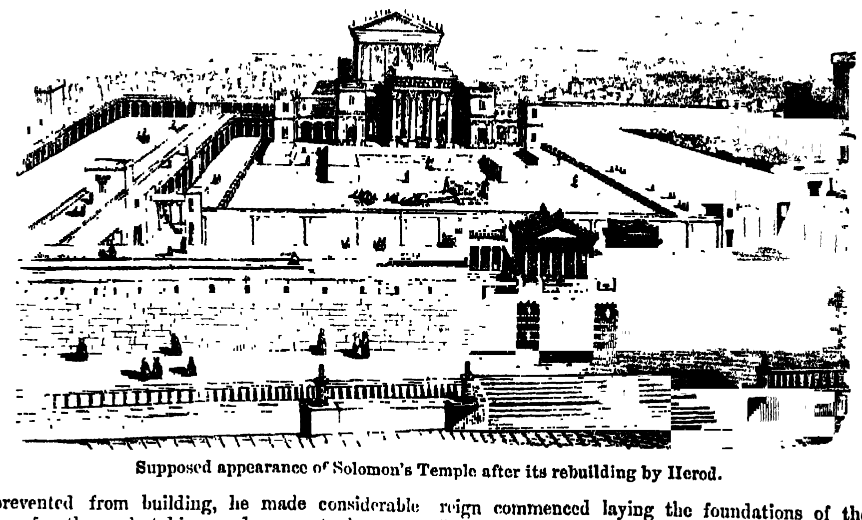
The destroyer of the Templars was the resolute and vindictive Philip IV. of France, surnamed Le Bel, one of the most remarkable sovereigns that France ever had. This monarch, it seems, had quarrelled with Pope Boniface VIII., whom the Templars had assisted with money. The king owed them a grudge for this, and besides they were very rich and he wanted money; so that when, in the beginning of 1305, the papal chair became occupied by Clement V., a creature of his own, he rapidly matured his plans for their destruction. During that year the king secured from two expelled members of the order, who were under sentence of death for conspiracy, a series of accusations against the Templars, in which they were charged with heresy, idolatry, profligacy, worship of the devil, and numerous other offences of equal magnitude. The king received these depositions personally, and rewarded the prisoners by remitting the death sentence and restoring them to liberty. During the next two years the grand master of the temple, Jacques du Molay, was drawn to France by a summons from the Pope, who professed a desire to consult with him on the expediency of a union of the military orders of the church. He was received both by the Pope and king with all suitable courtesies, and everything was done to lull the Templars into a sense of security. By the autumn of 1307 the plot was ripe for execution, and on 12th October of that year sealed royal letters were handed to all the governors of towns and other officers of the crown in authority throughout the kingdom, and the result was that the next day nearly all the Templars in France, Du Molay included, were in custody. Their houses and goods were also everywhere seized; the vast stronghold of the temple at Paris, the chief seat of the order in that kingdom, was entered and taken possession of by Philip himself; and on the 15th the prelates, heads of the university, and the abbots and priors of the

religious houses assembled in the Templars hall to draw up an act of accusation against the order. This was forthwith published, and Philip at the same time wrote to the Pope and the sovereigns of England, Germany, Aragon, Portugal, and Castile, intimating what he had done and calling upon them to second him. Edward II. of England expressed himself at first disinclined to believe what was said against the knights; but on soon after receiving letters from Clement he yielded, and the English Templars were also all seized and thrown into confinement. In France the Templars were treated with great cruelty, and the severest tortures were employed by their gaolers to obtain confessions of guilt. Many of them, under the stress of suffering, confessed everything that was required of them, only to deny it when the torture was removed, and the commissioners appointed to try them for a time hesitated to pronounce sentence of condemnation. The king, however, was not to be balked of his prey, and without waiting for the close of the proceedings he procured one of his creatures, the Archbishop of Sens, whose jurisdiction extended over Paris, to convoke his provincial council in that city on 10th May, 1310; and on 13th May, by command of that body, fifty-four of the knights who had retracted their confessions were burned at the stake in a field behind the abbey of St. Antoine. Six more were burned a few days later, and the example of the archbishop was imitated elsewhere in order to terrify the members of the order into submission. On 2nd May, 1312, Clement, on his own responsibility, the general council of Vienna then in session being averse to precipitate measures, issued a bull for the abolition of the Templars. In it he expressly declares that he does not pronounce "a definitive judgment" on the guilt of the Templars, the charges against them not being proven; but that to prevent the further growth of a monstrous scandal, and for the greater good of Christendom, he suppresses the order, reserving to the holy see a final judgment as well as the disposition of the persons and property of the members. Their movable property was for the most part appropriated by the sovereigns of the countries in which it was deposited; and although their lands were nominally transferred to the Hospitallers, the crown, as a general rule, by means of enormous fines, secured the disposition of them. In Spain the lands of the Templars were bestowed upon the Knights of Our Lady of Montesa, a new order, founded in 1317; and in Portugal the order assumed the name of the Knights of Christ, a society that has existed until the present day. Finally, the bull of suppression was publicly read at Paris, 18th March, 1314, the grand master being present, and on his denying the truth of its statement he was burned with his grand prior the same evening on one of the small islands of the Seine, about the spot where the statue of Henri IV. is now erected on the Pont Neuf. A tradition of the time asserts that when fastened to the stake he summoned the king and Pope to meet him at the bar of God, and this was supposed to be fulfilled in the sudden and unexpected deaths of both, which occurred shortly afterwards. A military order only, the Templars left no literature behind them.

The original residence of the Templars in London was on the south side of Holborn, whence they removed in 1185 to their new house at the western extremity of Fleet street, the site of which still retains the name of the Temple.

TEMPLE. The beautiful and familiar form of the Greek and Roman temples (the latter a mere colourless imitation of the former) is conditioned by the essentially out-of-door character of the religion. Their main features were external, and the sacred rooms within were comparatively small—precisely the opposite characteristics, in fact, from those which dominated the first Christian churches, the famous BASILICA type. [See the article and Plates on GREEK ARCHITECTURE.] The other great varieties of temples are described in the articles and Plates EGYPTIAN ARCHITECTURE, CHINESE ARCHITECTURE, and INDIAN ARCHITECTURE.

TEMPLE, SOLOMON'S. This celebrated structure was situated on Mount Moriah, in Jerusalem, facing the Mount of Olives. David, who had intended to build a temple to Jehovah, had been prevented by the prophet Nathan, but



Supposed appearance of Solomon's Temple after its rebuilding by Herod.

though prevented from building, he made considerable preparations for the undertaking, and seems to have set apart the best part of the plunder taken in his numerous wars for the use of his son. Solomon, on succeeding to the throne, obtained the assistance of Hiram, king of Ty , a friend and ally of his father, and in the fourth year of his reign commenced laying the foundations of the temple. To make the foundation was a laborious and difficult task, for the rocky eminences of Mount Moriah were at once of intense hardness and of great irregularity. These all required levelling, and the depth of the excavations which had to be made, and the massive masonry that

required to sustain the necessary filling in, have excited the astonishment of posterity. The walls were composed of enormous stones of great durability, which were selected and prepared before being conveyed to Jerusalem. The framework of the temple was most likely built of massive stone, but the whole of the interior was wainscotted with cedar, on which were carved figures of cherubim, palm-trees, and flowers. Over these and over the door was laid a covering of gold. Beams of cedar spanned the ceiling, and the floor was of cedar and fir, overlaid with gold. The dimensions of the temple were exactly double of those of the tabernacle, the Holy of Holies forming a cube of 20 cubits. On the outside of the walls of the temple were built a number of chambers, in three storeys, which formed a kind of monastery for the priests employed in the temple service, and also the necessary magazines, bake-houses, and workshops. The porch of the temple was adorned with splendid pillars, and outside of this stood the altar. There were two courts, the outer of which extended all round the temple. The people stood in the outer court and the priests in the inner one, the division between them being low enough to permit the people to behold the ministrations of the priests at the great altar of burnt offerings. The outer wall, which marked off the temple inclosure, consisted of three courses of stones and a row of cedar beams, but the Bible does not mention or describe any of the gateways or architectural ornaments of this inclosure.

Though of only moderate dimensions, the temple was remarkable for the richness of its materials and the elaborate character of its internal decoration, but we have little or nothing to indicate its external appearance. It is even a matter of dispute whether the general character of the temple was Egyptian, Phœnician, or Greek, but the evidence seems to preponderate in favour of the view which derives the style of architecture from the neighbouring Tyre. The time occupied in its erection was seven years and a half, and its first splendour lasted for forty years, at the close of which it was taken and plundered by Shishak, king of Egypt. After this it was frequently profaned and pillaged, but while it shared in all the vicissitudes of the kingdom of Judah it lasted for over four centuries, before it was destroyed by Nebuchadnezzar, B.C. 588. In the year 536 B.C. Cyrus permitted the Jews to colonize their native land, and restored to them some of the vessels taken by Nebuchadnezzar for the new temple they proposed to build. In the year 534 the first colonists, who returned under Zerubbabel and Jeshua, having secured the services of some Phœnician workmen, commenced the rebuilding of the temple, on a larger scale, but on the same plan as before. A few dimensions of the second temple are given in the Bible and by Josephus, but we have no description that would enable us to realize its appearance. From the figures given it would appear to have been about one-third larger than its predecessor, but it was inferior in point of beauty and splendour (Ezra iii. 12). In connection with this temple it may be noted that the prophet Ezekiel, who delivered his message in Babylonia, gives a vision of a temple such as he evidently desired should be constructed at Jerusalem; but his ideas were not carried into execution by the returned colonists, and they were only imperfectly carried out in the temple of Herod. The temple of Zerubbabel was pillaged and desecrated by Antiochus Epiphanes in the wars between 175 and 163 B.C., but in the year 165 B.C. it was partially restored by the Jews under Judas Maccabeus. It was stormed and taken by Pompey, B.C. 68, who inflicted great injuries upon the building, and caused a frightful massacre in its courts. It was also stormed and partially destroyed by Herod, B.C. 37, but when he had obtained possession of his kingdom he undertook to rebuild it in a style of superb magnificence. Herod's Temple was at once the last and greatest of the temples of Jehovah, but for our knowledge of it we are indebted almost wholly to Josephus, though a few hints are to be found in the New Testament and in the Talmud. From these sources we may gather that the chief approach to the temple was by a bridge crossing the ravine of the Cheesemakers' Valley, 350 feet long, 50 feet wide, the depth at the centre to the valley beneath being 225 feet, or only 20 feet less than that of the famous Clifton Suspension Bridge in England. This bridge led to the south-west entrance of the temple inclosure, where the road passed into the nave of the great royal cloister, running the whole length of the southern side. The temple area, bounded on the south by this royal cloister, was an irregular square, the shortest side (on the south) being 922 feet, the longest (on the north) 1150 feet in length. Along the east, north, and west sides ran more cloisters, though not on so grand a scale as the royal cloister on the south; the court within, paved with variegated marble, was the court of the Gentiles, which was open to all. This court contained houses for the Levites, a synagogue, stalls for the animals used for sacrifice, and shops for money-changers, who supplied visitors with the temple money. The inner boundary of this court was a low wall, 4 feet high, called the Soreg, pierced by gates, and placarded at intervals with inscriptions in Greek and Latin warning all Gentiles that further intrusion would involve the penalty of death. In the interior of this vast court rose a huge platform to which access was given by nine flights of steps. On this platform stood the holy house itself, with the courts for priests and people. The chief approach was through the great eastern portal, past gates overlaid with gold, and known as the "Beautiful" gates, immediately inside being the Court of the Women, which was open to both sexes, but beyond which women might not advance. It was this court that was used for ordinary worship, and here were placed the trumpet-shaped collection boxes for receiving the gifts of the worshippers. More steps led up to the smaller court of Israel, open to male Jews, and at a slight elevation above this was the court of the priests, which the people might not enter. It was surrounded by groups of chambers for all kinds of purposes connected with the temple service, and it contained the great altar and the Holy House itself. The latter was approached by a splendid porch, 150 feet long, and within lay the Holy Place, 60 feet by 30 feet, where stood the golden lampstand, the shewbread table, and the altar for incense. Beyond came the Holy of Holies, a chamber 30 feet square, entirely empty, and which, with the exception of a single visit once a year by the High Priest, was always left to silence and darkness. The grandest part of the building, from the architectural point of view, seems to have been the cloisters added to the outer court when it was enlarged by Herod. The great royal cloister on the south side was 922 feet long, and it contained 162 massive pillars, the nave being 45 feet broad and 100 feet high, the aisles on either hand being 30 feet in width and 50 in height. The other cloisters were composed of double rows of Corinthian columns, 37 feet 6 inches in height, with flat roofs and resting against the walls of the temple. Began about B.C. 20, the holy house or temple was finished in about a year and a half, and the outer buildings in eight years, although some of the building operations were left to be carried out by the successors of Herod. The temple was the scene of the last struggle of the Jews against the Romans, A.D. 70, and the termination of that struggle was contemporaneous with its final desolation. In the year A.D. 136 the Emperor Hadrian dedicated a temple to Jupiter Capitolinus on the ruins of the temple, and laid a tax upon the Jews for its support. At a later period the temple hill became a site for buildings for Christian worship, and still later, after the conquest of Jerusalem by the Saracens, a splendid mosque was built on the site by the Caliph Omar, which still stands there.

TEMPLE, SIR WILLIAM, a distinguished statesman, diplomatist, and miscellaneous writer, was born in London in 1628. He sprang from an ancient and honourable family, which is said to have taken its name from the manor of Temple in Leicestershire. Sir John Temple, his father, was master of the rolls in Ireland, and afterwards became a member of the Long Parliament, where he attached himself to the Presbyterian party, and was one of those moderate members who were expelled by Colonel Pride. His grandfather, Sir William Temple, originally secretary to Sir Philip Sidney, who died in his arms, was subsequently provost of Trinity College, Dublin, and a master in Chancery. In 1645 William Temple entered Emanuel College, Cambridge, where the celebrated Cudworth was his tutor. At the end of two years he left Cambridge without taking a degree, and set out upon his travels. On his way to France he passed through the Isle of Wight, where he met with Dorothy, second daughter of Sir Peter Osborne, who then held Guernsey for the king. An attachment, as strong as it was violent, sprang up between young Temple and the lady, which, after a most romantic courtship beset with difficulties, was consummated by their marriage in 1654. Temple passed six years in France, Holland, Flanders, and Germany, where he acquired a knowledge of continental languages, as well as various other accomplishments which were of great service to him in his subsequent diplomatic career. He made his first appearance in public life in the Irish Convention of 1660, and after the Restoration was elected member for Carlow in the Irish Parliament, where he showed great moderation and remarkable aptitude for business. In 1663 he repaired to London, where he spent two years, obtained an introduction to Clarendon, and to Arlington, secretary of state, and was sent by the latter, in 1665, on a mission to the Bishop of Munster. Although the scheme ended in nothing, Temple gave so much satisfaction to his employer that he was created a baronet, and appointed resident at the viceregal court of Brussels. Sir William, aided by his friendship with De Witt and other Dutchmen, had the principal share in the formation of that important league, the Triple Alliance, which interposed a formidable barrier to the ambitious designs of Louis XIV. He was next sent to Aix-la-Chapelle to assist in concluding a treaty between France and Spain; and after the close of this negotiation he was appointed ambassador at the Hague (August, 1668), where he was received with the utmost cordiality, and enjoyed the confidence both of De Witt and of the Prince of Orange. But Charles II. and his ministers had not abandoned, though they had been compelled to lay aside for a time, their base and perfidious continental policy; and the disgraceful treaty with France having been ratified, Temple was dismissed from his post in June, 1671, and war was declared against Holland. Sir William quietly withdrew to his seat at Sheen, near Richmond, where he amused himself with gardening, and wrote his "Account of the United Provinces," and one part of his "Miscellanies." Meanwhile public indignation was raised against the government. Their infamous measures were violently condemned both by the Parliament and the country, the "Cabal" was driven from office in disgrace, and the king sent for Temple and intrusted him with the office of negotiating a separate peace with Holland, which was concluded in three days. An attempt was soon after made to induce Temple to accept the office of secretary of state; but knowing well how little reliance could be placed upon the king, he refused to take a post of so much responsibility, and accepted instead the embassy to the Hague, in July, 1674. In July, 1677, he was sent for to England and was again earnestly pressed by the king to accept the seals of secretary of state, but resolutely declined the offer. He took a principal part, however, in bringing about the marriage of the Prince of Orange to the Princess Mary, the king's niece—an event which gave general satisfaction, and was fraught with momentous consequences. He soon after returned to his post, but was once more summoned to England in 1679, and vainly entreated for the third time to take the office of secretary. He recommended, however, as a remedy for existing evils, the dissolution of the existing Privy Council, and the formation of a new and enlarged council, consisting of the great officers of state, and of noblemen and gentlemen of large fortunes. The king adopted the recommendation, and nominated Temple himself, along with Lord William Russell and other leading Whigs, members of the new council. But the scheme was not well devised, and the perfidy and levity of the kings and the ambition of his ministers, soon rendered it inoperative. In 1679 Temple was chosen member for the University of Cambridge; but apparently unwilling to commit himself to either party, he absented himself from the house during the violent contests respecting the Exclusion Bill, and on the dissolution of the Parliament he retired from public life. After the Revolution he was frequently visited by William, who urged the veteran, statesman to enter his service, but without effect. He consented, however, that his son should take the office of secretary at war, but within a week after his appointment the young man committed suicide, from vexation at the unfortunate result of some advice which he had given the king. On this blow Sir William retired to Moor Park, where he passed the remainder of his life, having taken a distant connection of his wife's, the celebrated Jonathan Swift, to live with him as an amanuensis. "Stella" (Hester Johnson), who passed as the daughter of Sir William's steward in the house, and whose education Swift superintended, the more gladly as he was fond of the pretty child, has been by some supposed to have been a natural daughter of Temple's. In this secluded spot he wrote his memoirs, published several miscellaneous treatises, and gave at times confidential advice to the king, who was fond of visiting him and walking in his garden familiarly; and here he died in 1700, in his seventy-second year. Temple was not a profound or original thinker or a great scholar. But he was an accomplished man of the world, sagacious, steady, and moderate, fond of security, comfort, repose, and leisure, rather than ambitious of high office and power. Burnet accuses him of holding irreligious opinions, and there can be no doubt that he was timid, cold-hearted, and selfish. His principal works are "Memoirs from 1672 to 1691," "Account of the United Provinces," "An introduction to the History of England," "Letters," "Miscellanies," &c. Sir William Temple was very good to Swift, to whom he left a legacy and the office of his literary executor by way of starting his fortunes. A great deal of Swift's success was unquestionably due to his long training with Temple.

TEMPLEMORE, a market-town of Ireland, in the county of Tipperary, 35 miles N. by W. from Clonmel, and 79 S.W. from Dublin, by the Great Southern and Western Railway, is situated near the eastern base of the Devil's Bit Mountains, and not far from the right or west bank of the Suir. It is a well-built and neat town. The church, which has a handsome tower and spire, was rebuilt late in the last century. There are also a handsome and spacious Roman Catholic chapel, court-house, bridewell, barracks, fever hospital and dispensary, endowed school, and ball and news rooms. Templemore has a good inland trade. The neighbouring district is rich. The town is approached on all sides by avenues of ash trees. It derives its name from the Knights Templars, who had a house here. Adjoining is the "Priory," the grounds of which are open to the public; and the manner in which the place is kept, and the hedgerow trees around, give to that side of Templemore a very rural and pleasing appearance. The population in 1881 was 2900.

TEM'PO, a musical term expressing the rate of speed at which a piece is to be played or sung; and which is to be distinguished from *time*, the musical term expressing the number of accents in each bar or measure. The chief terms of tempo (often inaccurately called "time") are these, proceeding from the slowest to the quickest:—Grave, Largo, Lento, Adagio, Andante, Moderato, Vivace, Allegro, Presto. Larghetto, Adagietto, and Allegretto imply a pace rather slower than the *tempi*, of which they are diminutives. Andantino, on the other hand, is rather quicker than Andante. Prestissimo is much quicker than Presto, in fact, as quickly as it is possible to move.

The best way to express tempo is undoubtedly by the use of the metronome, as well as the proper word, since a composer by writing in notes of high value with a low tempo (say a rush of semiquavers in an adagio, not unfrequent in Beethoven), or *vice versâ*, has the power to alter the character of the piece very considerably. If, however, the metronomic sign be used, as for instance 𝅗𝅥 = 120, the performer knows exactly at what pace he is to proceed, namely, two minims to a second. The tempo signs are, however, still necessary to indicate the general character of the effect desired to be produced.

TEM'PUS, one of the mediæval modes of musical division, was of two kinds, *perfectum* and *imperfectum*. Perfect time was indicated by O, and in it the breve was divided into three semibreves; imperfect time by C, and in it the breve was divided into two semibreves. The idea of "perfect" attaching to the circular form and to the Trinity explains the sign and the division. We now express the triple division by a circular dot, the old circle of perfection having shrunk to that dimension; and the dot, moreover, is attached to each triple note, whereas the old circle of perfection was placed at the beginning of the line, and dominated the division throughout, like our modern time-signs. We still retain the imperfect sign in the form of 𝄴 to express our ordinary duple division or "common time," better expressed by $\frac{4}{4}$. The "tempus" dividing a maxim into longs, or a long into breves, was called *modus;* and that dividing a semibreve into minims was called *prolatio;* for it was the delight of our forefathers to make as many names as possible, while we on the other hand strive always at generalization.

TEN THOUSAND, RETREAT OF THE, a famous military expedition of the ancient Greeks, B.C. 401. See ANABASIS.

TENA'CITY (from the Latin *tenacitas*, the power of holding), a property of material bodies by which their parts resist an effort to force them asunder, differing widely in different materials, and varying in every material with the state of the body with respect to temperature and other circumstances.

The molecules of liquids adhere to one another, and generally to those of solid bodies, by attractive forces which decrease very rapidly; and at insensible distances from the supposed places of contact, the adhesion entirely disappears. It is on account of the small distance to which the attractions of the fluid molecules extend, and to the freedom with which the particles move on one another, that fluids appear to have so little tenacity; but from the weight which it supports in glass tubes, it has been estimated that the mutual attractions of the particles of water on a surface equal to one square inch must far exceed 190 lbs.

The tenacity of solids constitutes, in part, the subject of the powers of bodies to resist strains; and under MATERIALS, STRENGTH OF, will be found a table of the weights which would overcome the force of cohesion in rods immovably fixed at one end and pulled in the direction of their length: those weights may be considered as the measure of tenacity in the different kinds of material. The tenacity of wood is much greater in the direction of the length of its fibres than in the transverse direction, the fibres being united by a substance having little cohesive power. With respect to metals, the processes of forging and wire-drawing increase their tenacity in the longitudinal direction; the augmentation of friction and lateral cohesion, arising from the particles being forced together in the transverse direction, more than compensates for the diminution of the attraction which may result from the particles being forced or drawn further asunder longitudinally. Copper and iron have their tenacity more than doubled, while gold, silver, brass, and lead have it more than tripled by those metals being drawn into wire.

TENAILLE, in fortification, is a rampart raised in the main ditch, immediately in front of the curtain between two bastions: and in its most simple form it consists of two faces coinciding in direction with the faces of the bastions, and consequently forming with each other a reentering angle. Generally, however, it consists of three faces, of which two have the directions just mentioned, and the third forms a curtain which is parallel to that of the enceinte.

TENANT. See LANDLORD AND TENANT.

TENANT RIGHT is the name for a species of customary estates peculiar to the northern parts of England, in which border services against Scotland were performed before the political union of the countries. Tenant right estates were holden of the lord of the manor by payment of certain customary rents and the render of the services above mentioned, were descendible from ancestor to heir according to a customary mode differing in some respects from the rule of descent at common law, and were not devisable by will either directly or by means of a will and surrender to the use of the same, though they are now made devisable by 1 Vict. c. 26, s. 3. Although these estates appear to have many incidents which do not properly belong to villenage tenure or copyhold, not being holden at the will of the lord, or by copy of court roll, and being alienable by deed and admittance thereon, it has been determined that they are not freehold, but that they fall under the same general rules as copyhold estates.

In Ireland the term tenant right is given to a custom entitling an outgoing tenant of a farm to compensation for unexhausted improvements, for the rules of which see the Agricultural Holdings Act of 1883. It is also used to designate a custom either insuring a permanence of tenure without liability to any other increase of rent than may be sanctioned by local custom, or entitling a tenant to receive purchase money for what may be called the good-will of his farm. See the Land Law (Ireland) Act, 1881, in the article IRELAND.

TENAS'SERIM (*Ta-neng-tha-ri*), a division of the province of British Burma, comprising the six districts of Amherst, Tavoy, Mergui, Shwe-gyeng, Toung-ngu, and the Salwin Hill Tracts. The area is 46,780 square miles, and the population 600,000. These districts formed the tract south of Pegu conquered from Burma in 1826, and were for many years generally known under their official name of the Tenasserim Provinces. The population consists chiefly of Burmese; but there are several distinct races, in all of which, however, the Mongol blood is distinctly traceable. The surface is mostly mountainous, and covered with fine forests; there are, however, some extensive and very rich alluvial plains, broken only by isolated peaks of limestone, and well adapted to the culture of cotton, indigo, and tobacco, which with rice, sugar cane, numerous fruits, excellent teak and sapan wood in the north, bamboos, rattans, various drugs and gums, betel, cocoa nuts, balachang, tortoise-shell, and horns are the chief productions. The forests occupy two-thirds of the entire area, and only about a fifteenth of the country is under cultivation. The

principal rivers are the Salwin, the Gyen, the Attaram, the Ye, the Tavoy, and the Tenasserim, most of which are navigable to some distance inland. Along the whole extent of Tenasserim islands of various magnitudes occur within a short distance of the shore, of which from the sea they appear to form parts. Balu (*Balu-gyun*), opposite Maulmain, by far the most important, has alluvial lands of surprising fertility. Many of the smaller islands are famous for their edible birds' nests. The climate of Tenasserim is healthy, the thermometer ranging from 75° to 98°. The annual fall of rain is 108 inches. The rainy season continues from May to October after a dry season of six months. Rich iron and tin ores and coal are plentiful in the provinces of Tavoy and Mergui, but few, if any, mines are worked. Valuable lead ore is found in the latter province, and manganese is abundant on the River. In fact, the province is a vast sto mineral wealth, which as yet has been but imperfectly developed. Elephants, rhinoceroses, tigers, the wild hog, and great numbers of deer abound in the forests. The population are mostly Buddhists, except the Karens, a dispersed people living in secluded mountain districts, and among whom Christianity has made some progress, chiefly through the efforts of the American missionaries. The inhabitants manufacture cotton and some silk fabrics; but the use of these has been almost superseded of late years by the importation of Indian and British articles. The ports are entirely free, and many vessels are built on the coast. The country is at present divided into the provinces of Amherst or Maulmain, Tavoy, and Mergui, named after their chief towns, which are the principal seats of the foreign trade. The chief exports are teak, timber, and rice. Amherst harbour affords good anchorage for the largest vessels, but is difficult of approach. Tenasserim appears t sited by the Portuguese arly in the seven th century. It passed into the hands of the English by the peace of Yandabo, which terminated the Burmese War in 1826. The American missionary, Malcolm, in his "South-eastern Asia," says: "English influence has improved the condition of the people in a variety of ways. It has abolished the border wars, which kept them nd eir neighbours continually wretched. Various other improvements are percept Coin has been introduced instead of masses of lead and silver; manufactures are improving; implements of better construction are used; justice is better administered; life is secure; property sacred; relig is free; taxes, heavy, are more equitably imposed; and courts of justice are generally pure. Formerly men were deterred from gathering round them comforts superior to their neighbours or building better houses for fear of exactions. Now being secure in their earnings, the newly-built houses are much improved in size, mate ls, and workmanship. he presiding officer in each p vince sits as magistrate on certain days every week and before him every citizen, male or female, without the intervention of lawyers, may plead his or her cause, and have immediate redress. Everywhere in British Burma the people praise the English justice."

TEN'BURY, a small town of England, in the county of, and 18 miles N.N.W. of Worcester, situated 167 miles by rail from London, on the river Teme, at the confluence of the Kyre, among hop grounds and orchards. A medicinal spring here has some notoriety. The population in 1881 was 20‥.

TEN'BY, a small municipal borough and watering-place of Wale, in the county of Pembroke, situated on the western side of Carmarthen Bay, 10 miles east from Pembroke, and 269 from London by the Great Western and Pembroke and Tenby railways. The sands are extensive, and the surrounding scenery presents an inexhaustible variety of picturesque landscapes. The climate is mild and well adapted for patients suffering from pulmonary disease, and the place is rapidly becoming a favourite resort. There are some good hotels, lodging houses, libraries, assembly rooms, churches, chapels, and schools. An oyster fishery is carried on. The population in 1881 was 4783. Near the town is a large marble statue of the Prince Consort—known as the Welsh Albert memorial. The corporation consists of four aldermen and twelve councillors including the mayor. Tenby is a town of ancient date; its old British name is *Dynbych-y-Pysgod*, which signifies either the Precipice of Fishes or Denbigh the Fishy, thus called from its peculiar advantages as a fishing town, and also to distinguish it from the town of Denbigh in North Wales. In 878 the Danes wintered in Pembrokeshire, and remained in the neighbourhood until 1089. Henry VII., who was born in Pembroke Castle, was in Tenby after the battle of Tewksbu d escaped thence by the assistance of a merchant of the place, who conveyed him to Brittany. There are considerable remains of the ancient fortifications.

TENCH (*Tinca vulgaris*) is a species of fresh water fish belonging to the CARP family (Cyprinidæ). The tench has a thick short body covered with a thick skin, in which the small scales are deeply embedded. The head is rather thick and blunt, and there is a small barbel at the angle of the mouth on each side. The dorsal fin is short, and has no spine; it is placed opposite the ventral fins, which are large; the pectoral fins are large and rounded. The lateral line is complete. The pharyngeal teeth are in a single row, wedge-shaped, and slightly hooked at the end.

The tench inhabits most of the lakes of the European continent. In this country, though frequent in ornamental waters and ponds, it is but sparingly found in our rivers. There is some doubt whether, like the carp, its origin be not for gn, and whether those rivers that can now boast of it are not indebted for it to the accidental escape of fish from the preserved waters of neighbouring gentlemen. The rivers it mostly frequents are those which are slow and deep, and in such situations it does not appear to be so prolific as in ponds. It inhabits by preference stagnant waters with a soft bottom. It is very tenacious of life, and passes the winter in a state of torpidity, buried in the mud. It spawns in June, and is very prolific, nearly 300,000 eggs having been counted in a female. It seldom exceeds a weight of 5 or 6 lbs. and a length of 18 inches, though specimens have been taken measuring 33 inches and weighing as much as 11 or 12 lbs. It is generally of a yellowish brown colour, sometimes greenish. Occasionally, by a kind of incipient albinism, it acquires a golden tint. The flesh of well-fed specimens has a delicate flavour. It is angled for in the same way as the carp.

TEN'DER. A tender is the offer to perform some act. In practice it generally consists in an offer to pay money on behalf of a party indebted, or who has done some injury to the creditor, or to the party injured.

A tender to the amount of 40*s.* may be in silver; but beyond that amount it must be in gold, or in Bank of England notes payable to bearer on demand, for any sum above £5. The money must be produced and shown to the party to whom it is intended to be given, unless this is dispensed with by some declaration or act of the creditor. The offer must also be absolute and without conditions.

If the defendant in an action plead a tender, he must state that he has always been ready to pay the money, and he must also pay it into court. The effect of the plea is to admit the existence of the contract or other facts stated in the declaration which form the cause of action in the plaintiff. The plea goes only in bar of damages. The plaintiff, therefore, in such cases can never be nonsuited; but if issue is taken on the mere fact whether or not the tender has been made, and that fact is found for the defendant, it is a good defence to the action.

TEN'DON or **SINEW,** the tough white and shining tissue by which muscles are attached to the bones or other parts which it is their office to move.

The fibrous or tendinous tissue is of a peculiarly glistening bluish-white colour, dense and tough, nearly insensible, not vitally contractile, and very little elastic. It is composed of bundles of delicate fibres, which are united by cellular tissue; and each fibre is made up of several fibrillæ or filaments, which are discernible only with the microscope. The filaments are transparent and cylindrical, with well-defined outlines; they vary in diameter from 1-30,000th to 1-10,000th of an inch, and, though they have a generally straight direction, are finely undulated. The tendinous fibres are from 1-7500th to 1-3750th of an inch in diameter; the filaments are arranged within them in parallel lines, and connected by a firm substance, in which no distinct structure can be discerned. The bundles of the fibres are arranged in various plans in the different tendons and aponeuroses; in some they are parallel, in others interlaced or variously woven together; but their arrangement is always such that they possess the greatest force of resistance in the direction in which the muscle acts upon them. The tendons, like all fibrous tissues, are composed of a substance slowly yielding gelatine by boiling.

At that end of a tendon which is affixed to a muscle, each primitive fibre or fasciculus of the muscle terminates in an abruptly-rounded extremity, which is embraced by a fasciculus of the filaments of the tendon, expanding and inclosing it in a sheath, or in a manner which may be roughly represented by placing the end of the forefinger of one hand within a circle formed by the ends of all the fingers of the other hand. The larger bundles of cellular and fibrous tissue in the tendon are also continuous with the cellular tissue which is placed between the secondary fasciculi of the muscle.

At their opposite extremities the tendons are usually affixed to bones. Their fibres are intermixed and firmly united with those of the periosteum, and often pass into the very substance of the bone.

Although the chief and proper office of tendons is to serve as media for the action of muscles, yet many of them fulfil other purposes in the human economy. Thus the aponeuroses of the abdominal muscles form a great part of the walls of the abdomen, and by their toughness support and protect the organs within its cavity; the tendons of the muscles of the fingers add strength to each joint over which they pass; and many in other parts are arranged so as to act like ligaments.

TEN'DRIL, in botany, is the name applied to the thread-like elongated parts of plants which possess the property of curving round slender solid supports with which they come into contact during growth, and to which they fix the plant on which they grow. Tendrils are not homologous organs, but are modifications of parts of branches or leaves. In the parasitic dodder the entire stem may be regarded as a tendril. In the vine, Virginian creeper, and passion-flower the tendrils are formed by metamorphosed flowering branches. In clematis and some other plants the petioles of the leaves serve as tendrils. In the fumitory the whole of the finely divided leaf is sensitive to contact, and its separate parts act as tendrils. In the pea, and many of its allies of the tribe Papilionaceæ, the apical part of the pinnate leaf is transformed into slender tendrils; in *Lathyrus Aphaca*, a species of the genus to which the sweet-pea belongs, the whole leaf may be regarded as a tendril, the blade being absent.

The twining of tendrils is ultimately due to unequal growth on one side of the organ. When the tendril is still young and growing, it, as well as the shoot which bears it, revolves and curves along its whole length, except at the base and the extreme apex, which is hooked. When any part of the curved sensitive surface touches a support, the tendril begins to curl round the latter, until the whole length between the point of contact and the tip is wound in a spiral coil round the support. This is followed usually by the spiral coiling of the rest of the tendril, so that the whole organ is considerably shortened, and the shoot, which bears it, is firmly attached to the support. If the tendril does not come into contact with anything round which it can twine, it loses its sensitiveness in a few days on attaining its full growth, and either drops off or rolls up slowly into a spiral form and dries up, becoming woody. Sometimes the contact is only temporary, and the tendril then straightens itself again. See MOVEMENTS OF PLANTS.

TEN'EBRÆ, a famous service in the Roman Catholic Church. It is very long, and is sung late in the afternoon on the Wednesday, Thursday, and Friday (Good Friday), in Passion Week—the intention being that the service shall last until the church is quite dark, and so symbolize the darkness (*tenebræ*) overspreading the earth at the crucifixion.

The office contains no less than sixteen psalms and a canticle, with dividing antiphons cutting them into fourteen divisions, and there are [illegible]le responsaries. Then follows the Canticle, Benedictus, Dominus, Deus, Israel, and lastly Psalm li. *Miserere mei Deus*, the performance of which by the Sistine Choir is always [illegible]sidered by competent musicians to be one of the most marvellous effects producible by sound. This is largely due, as will be seen, to the accompanying circumstances. At the beginning of the service the church is lighted by six tall candles on the altar, and fifteen on a large triangular frame in front (for the twelve apostles and the three Maries). Of these latter, one is extinguished at the end of each division of the long service, till at last only one remains. Then, during the singing of the Benedictus, the six altar-lights are put out one by one. The last candle of the fifteen is still burning, and this is now carried behind the altar, so that all is in darkness. Hitherto the long service has been chanted in unison to the monotonous plain-song of the day, the voices of the crowded priests harshly clashing against one another as the "cantoris" side answers to the "decani." But this continuous hammering at the gate of the ear, which has lasted through the glowing gloom till ladies have turned faint and men are heartily weary, ceases with the removal of the last candle. All is silence and darkness while a high soprano voice sings, "Christus factus est pro nobis obediens usque ad mortem" (Christ, for our sake, became obedient unto death). Then all is silence, and in the dark every one present is supposed to repeat the Lord's Prayer. The "Miserere" now steals upon the silence in full harmony, the sweetness and richness of which, as it swells from a scarcely audible softness into delicate pathos, cannot be described, coming after all the harsh rapid chanting of the priests. Every alternate verse of the "Miserere" is so chanted, and again and again the sweet effect of the contrasting harmonies of the choir soothes the jarred nerves. At the close of this impressive ceremony the priests noisily scrape their feet on the pavement, symbolizing the tumult made by the Jews in seizing Christ; then the single taper, yet alight, is brought out from behind the altar, and the congregation disperses.

Mendelssohn, in his letters from Italy, speaks with profound respect of the service as he heard it by the Sistine Choir, and Mozart, as a boy of fourteen (in 1770), was so struck by the effect of the "Miserere," then kept a dead secret, and the notes never allowed to be seen, that he carried the whole parts away in his mind and wrote them down at home, a most astonishing feat. Three settings of the "Miserere" are now in alternate use—one by Allegri, written about 1640, and extremely beautiful, which is the one copied by Mozart; another by Bai, written in 1714;

and a third by Baini, in 1822. In themselves they are in simple part writing, so that when the Emperor Leopold I. obtained a copy of Allegri's Miserere, after much solicitation, he thought he was the victim of a trick, for it was comparatively ineffective. But as the Sistine Choir and other similar choirs perform these compositions, each voice in turn enriches its part with exquisite embellishments or variations, the one voice melting into the other in an indescribably beautiful and mysterious way, so that while one clearly distinguishes the chord the actual notes are hard to define amidst the constant movement and play of the parts. Mendelssohn has sketched some of these *abbellimenti*, and Mozart is known to have noted several of them in his famous copy, now unhappily lost.

TENE'BRIO. See MEAL-WORM.

TEN'EDOS (in earliest antiquity *Calydna*, *Leucophrys*, *Phœnicia*, and *Lyrnessus*), a small island about 10 miles in circumference, in the Grecian archipelago, now belonging to Turkey, 13 miles from the mouth of the Hellespont, and 4 miles west of the coast of the Troad; population about 7000, two thirds Greeks. The interior is fertile and well cultivated, producing corn, cotton, fruits, and excellent wine. The small town of Tenedos, on the east coast, has a good port, and is defended by two forts. In the legend of the Trojan War the island is mentioned as the place to which the Greeks withdrew their fleet, in order to make the Trojans think that they had departed, after leaving the wooden horse before Troy; and it was employed in the Persian War by Xerxes as a naval station. Subsequently, on several occasions, as in the Peloponnesian, Macedonian, and Mithradatic wars, it figured conspicuously as a stronghold; and in the middle ages the Turks and Venetians long contested its possession.

TEN'EMENT, in its usual and popular acceptation, is applied only to houses and other buildings; but in its original, proper, and legal meaning, it includes everything of a permanent nature that may be an object of tenure, or may be held in the legal sense, whether corporeal or incorporeal. It includes not only land, but every modification of right concerning it. Thus the word *liberum tenementum*, frank-tenement, or freehold, is applicable not only to lands and other solid objects, but also to offices, rents, commons, and the like.

TENERIFFE, the largest island of the Canary group, 160 miles north-west of Cape Bojador. It has an area of about 877 square miles, and the population is 100,000. About one-seventh of the surface is fit for cultivation; the remainder is covered with lava and other volcanic matter, and a great part of it is entirely destitute of vegetation. The highest point on the island is the Pico de Teyde, or Peak of Teneriffe, a dormant volcano, rising to the height of 12,182 feet above the sea. The crater measures 300 feet by 200; it is surrounded by a circular wall 40 feet high, which from a distance has the appearance of a cylinder placed on a truncated cone. The Peak rises above the current of the trade-winds, and is always exposed to a violent continuous gale from the west. The view of this mountain from Orotava on the west coast is magnificent, from the contrast of the rich cultivated plain and the leafy forests with the barren, wild, and stern aspect of the Peak. Teyde is connected by a mountain ridge with another crater called Chahorra, which is 9888 feet high. Sulphurous vapours are constantly issuing from the crevices in these craters. To the west of Chahorra there are four volcanic cones, which were in a state of eruption in 1798. The Pico de Teyde is surrounded on the south and east by a continuous chain of mountains, inclosing a semicircular plain of about 3 miles' radius, which is called Llanos de las Retamas, from a plant, *retama*, almost the only vegetable that grows on it. The whole plain is nearly covered with pumice stone. The country west and north of the Peak descends with rapid broken slopes towards the sea. The outer edge of the semicircular mountains is surrounded by high table-lands, which, together with the region of the Peak, cover nearly half the island, and contain some pine forests. Towards the north-east these table lands, which have a very broken surface, extend for about 20 miles, and terminate in the plain of Laguna. This plain, which is nearly in the middle of the island, is of considerable extent; it is shut in by hills, and is nearly a dead level. After the rains it is partially covered with water, from which circumstance it takes its name. It produces abundance of grain, but no trees. The eastern part of the island consists of numerous fertile valleys separated by basaltic hills, the highest of which, the Bufadero, is 3069 feet above the sea. This part produces the finest fruits in the island. The valley of Taoro, in the northern part of the island, is of great extent and of extraordinary fertility.

In Teneriffe all European domestic animals, and also white camels, are reared. Cattle are kept for slaughter and the plough. Goats, sheep, asses, and mules, are numerous. The silkworm is extensively reared. Bees also are numerous, and a great deal of excellent honey is collected. Rabbits, wild fowl, and turkeys, and all kinds of poultry are very plentiful. The sugar-cane, coffee, and tobacco are successfully cultivated, but at present in small quantities. Linen and woollen stuffs are manufactured by each family, generally for its own use. Some silk stuffs, earthenware, soap, vermicelli, leather, brandy, ropes from the agave, hats, baskets, and mats of palm leaves, are the other chief articles of manufacture. The imports consist of iron utensils, hardware, bar-iron, flax, glass, pottery, leather, candles, cotton goods, provisions, cod, &c.; the exports are barilla, almonds, cochineal, and dried fruits. The port of Santa Cruz is in course of improvement, and will when completed afford a safe and good anchorage at all times of the year, whilst the connection of the island with Europe by telegraph through Cadiz is likely to add greatly to its importance as an Atlantic port of call.

In 1886 it was proposed to establish near Orotava, in the island of Teneriffe, a great health resort on the plan of similar places in Switzerland; it is said, however, that for acute diseases of the chest the climate is too dry, but that merely as a pleasure winter resort it is very enjoyable.

TENG-CHOW-FOO, a city and seaport of China, in the province of Shangtung, on the strait of the Gulf of Pe-chi-li, 270 miles south-east of Pekin. Its port was opened to foreign trade by the treaty of Tientsin in 1858. Its imports consist chiefly of opium, cotton cloths, beans, and pease. Its harbour is secure, but the roadstead is not good, and the trade is not extensive. The population is estimated at 230,000.

TEN'IERS, DAVID, the name of two celebrated Flemish *genre* painters. The elder was born at Antwerp in 1582, and was received into the painter's guild in 1606. He was married at Antwerp in 1608, and died there in 1649. He worked under Rubens, and at one time he resided in Rome. His pictures, usually landscape, are able, but somewhat coarse in execution. His son and pupil, David, born also at Antwerp in 1610, was a much more talented painter than the father, following somewhat the steps of Brouwer—painting fairs, markets, merry-makings, beer-houses, guard-rooms, and other interiors, executed with wonderful precision and skill. But it matters not what the subjects of these marvellous works are, the genius of Teniers is manifest alike, through low or high surroundings. He was the real founder of the glories of the great Flemish school of genre, and yet one can trace the effects of the diligent study under Rubens, which he is known to have enjoyed. Teniers is not only the best delineator of the manners and customs of his contemporaries in every rank (for his work includes all classes of society), but is simply the greatest genre painter of any period. The leading characteristics of his style are force combined with

lightness of touch, every stroke being full of meaning. His execution of details is as full of delicacy as his arrangement of the whole is harmoniously balanced and spirited, while a keen sense of humour is always allowed to peep forth. His method of painting, however, varies; some of his pictures being painted solidly with a thick impaste, in others the colour is so thinly driven that the ground is barely covered. The younger Teniers was a rapid painter, and enjoyed the highest patronage; he was accordingly most successful in his career, and acquired a considerable fortune. He bought himself a country seat at the village of Perck, near Antwerp, where he kept a sort of court; his house being a constant resort of the people of rank and wealth of his time. He became director of the Academy of Antwerp in 1644. He was court painter to the Archduke Leopold William; and Don Juan of Austria was his pupil in painting. He died at Brussels in 1694, and was buried at Perck. The genuine pictures of Teniers are very numerous; but half the works attributed to him are certainly some by his father, and others by his clever scholars and imitators. There are also some clever etchings by Teniers. Good examples of the works of both father and son may be seen at Dulwich, and in the National Gallery, London: in fact many of the finest works of the younger Teniers are in this country.

TENNESSEE', one of the United States of North America, situated in the basin of the Mississippi, and bounded N. by Kentucky and Virginia, E. by North Carolina, W. by Arkansas, and S. by Mississippi, Alabama, and Georgia. The greatest length east to west is about 115 miles; the mean breadth north to south is 114 miles. The area is 45,600 square miles. The population in 1880 was 1,542,359.

Surface and Soil.—This state is naturally divided into three regions, which may be called the eastern, middle, and western. East and west Tennessee are nearly equal in extent, each comprehending about 10,000 square miles; the middle region contains about 25,000 square miles.

The country has a delightfully temperate climate. In the east it is separated from North Carolina by different ridges of the Appalachian chain, passing under the various local names of Stone, Iron, Bald, and Unaka Mountains. Then follow the valleys of the Holston and other rivers, forming the head-waters of the Tennessee. Next succeed the Cumberland Mountains, an outlying ridge of the Alleghanies, which enters the state from Kentucky, and crosses it in a south-west direction into Alabama. The height of these mountains, which spread over about 50 miles, is variously estimated at from 1000 to 2000 feet. They are wooded to the tops, and embosom delightful and fertile valleys. Their summits are often rounded and cultivated, while others are too rugged for tillage. Middle Tennessee, lying between these mountains and the Tennessee River, is moderately hilly, while the section between the last-named river and the Mississippi, called West Tennessee, is either level or gently undulating.

Gold has been found in the south-east part of the state. Among the other metallic minerals are, iron in abundance, and in East and Middle Tennessee lead, silver, zinc, manganese, and magnetic iron. Of the earthy minerals, coal, the most abundant and valuable, is found in large quantities among the Cumberland Mountains, covering an area, according to Taylor, of 4300 square miles. There is also gypsum of a fine quality, beautiful varieties of marble, nitre, slate, alum, and limestone; the last forming the bed of a large portion of the state. Salt springs exist, but not of a very rich quality: the mineral springs are valuable. Rich deposits of copper are found in the south-east, and extensively worked.

Tennessee is bounded on the W. by the river Mississippi, and twice crossed by the river whose name it bears. The latter enters the south-east of the state from North Carolina, receives the Holston and its tributaries from Virginia, and the Hiawassee from Georgia, then turns to the south-west into Alabama at its north-east angle, and leaves it at its north west to re-enter Tennessee, which it crosses in a course almost directly N. into Kentucky, and joins the Ohio. The Hatchee, a tributary of the Mississippi; Duck River, of the Tennessee, from Middle Tennessee; and the Holston, Powell's, and Clinch, tributaries of the same rivers in East Tennessee, are the other principal streams. The Tennessee has a total course of nearly 900 miles, about 400 of which are within this state, and 700 navigable for steamboats (with the exception of that portion in Alabama called the Mussel Shoals) to its junction with the Holston in East Tennessee. The Cumberland, which rises in Kentucky, makes a bend into the north of the state, through which it runs for about 150 miles before returning to Kentucky, thus giving that portion of the country water communication with the other parts of the great Mississippi and Ohio valleys. The river is navigable 400 miles for steamboats to Carthage, about 50 miles above Nashville, in a direct line. The tributary streams are all more or less navigable, either for steam or keel boats, during high water. All the waters of this state ultimately reach the Mississippi, though generally by a circuitous route.

In common with other limestone regions, Tennessee has numerous caves. Some of them are several miles in length, and one has been descended for about 400 feet below the surface, where was found a stream of sufficient force to turn a mill. These caves all occur in the Cumberland Mountains. Near Manchester, in Coffee county, is an old stone fort situated between two rivers, and including 47 acres, inclosed by a wall, on which trees are growing believed to be 500 years old.

The climate of Tennessee is mild and, except on the shores of the great rivers, healthy. A good deal of snow sometimes falls in the winter, which, however, is generally short. The summers are free from the intense heat of the Gulf states. The temperature of that portion of the state situated near the Cumberland Mountains is particularly agreeable. The soil of the middle of Tennessee is generally arable and of good quality. In East Tennessee much of the land among the mountains is poor and ill adapted to cultivation, but even here the valleys are very fertile. This part is favourable to grazing, and great numbers of live stock are exported from thence to the Atlantic states. A larger number of mules are bred in Tennessee than in any other part of the Union; it is also rich in horses, cattle, sheep, and swine very large herds of the latter running wild in the woods, and feeding mostly on nuts and acorns. Western Tennessee has a rich black mould, and on the shores of the Mississippi and Tennessee rivers are extensive brakes of gigantic cane. Indian corn, tobacco, and cotton are the principal crops. The other articles cultivated are wheat, rye, oats, buckwheat, barley, sweet and Irish potatoes, wood maple sugar, flax, hemp, apples, pears, and plums. The forest trees are pine (in East Tennessee), sugar-maple, juniper, red cedar, poplar, hickory, walnut, oak, beech, sycamore, locust, cherry, &c. The wild animals are the same as are found in the adjacent states of Kentucky and Virginia, viz., deer, racoons, foxes, squirrels, and a few bears in the wilder parts of the state. Pheasants, partridges, pigeons, swans, turkeys, ducks, and geese are very abundant.

Tennessee has comparatively little foreign commerce, but is very favourably located for domestic trade by means of its rivers. The exports are live stock, pork, bacon, lard, butter, ginseng, cotton bagging, flour, Indian corn, fruits, tobacco, cotton, hemp, feathers, and saltpetre, which are mostly sent to New Orleans, and thence either to northern or foreign ports. Nashville is the seat of government. Chattanooga a town on the Tennessee, 250 miles below

Knoxville, and 140 miles south-east of Nashville, at the terminus of two important railways, was captured by the Federals, 9th September, 1863, and ten days afterwards the desperate but indecisive battle of Chickamauga, between Generals Rosencranz and Bragg, was fought near it. Population in 1870, 6093.

History.—The first settlements in Tennessee were made about the middle of the last century, but in 1760 they were destroyed by the Cherokees, then the possessors of this country, from the northern and central part of which they were expelled in 1780. But in the next half century the number of settlements continually and rapidly increased. Up to 1790 it formed a part of North Carolina, but in that year it was ceded by that state to the United States, who converted it into a territory. In 1796 it was constituted a state. It joined the Confederate States in 1861, and was the scene of the important battles of Murfreesborough and Chattanooga.

TENNIS, a game of ball, formerly called "The Royal Game," is played in a court built for the purpose, with a playing floor 112 by 40 feet, end walls 30 feet high, side walls 20 feet high, and usually lighted by skylights or windows above the 20-foot line. The players are two or four persons divided as partners on the "service" side and the "hazard" side. The ball is struck with a bat, called a racket, the striking part of which is covered with a close hard network of tendon. The player or party in strikes a ball, or "serves" it, against the head wall of the court. This ball must come to the ground over "the line," which is a network stretched across the middle of the court, 5 feet high at each end and 3 feet high in the middle. It is returned by the player or party out, who must in turn deliver it, by its rebound, at a certain place in the court, when it is again struck by the player in; and so the game continues. Whoever fails to "put the ball up" properly on the head wall, or to deliver it at the proper place on the court, loses. If it is the player in that fails, he loses his hand and goes out; if it is the player already out, his adversary scores a stroke toward game. There are several other contingencies which go to making the score, and the numerous angles caused by the walls constitute the intricacies of the game.

The name is from the French *tenez*, hold, as in striking the ball the racket must be held firmly. The game originated in France in the fifteenth century, and Louis XI., Henry II., and Charles IX. were expert players. M. Barre, who died in 1873, for many years superintendent of the tennis court in the Tuileries, was considered the best player that ever lived. The oldest English tennis court was built early in the sixteenth century in Hampton Court Palace.

TENNIS, LAWN. See LAWN TENNIS.

TENNYSON, ALFRED, BARON, a distinguished English poet, was born at Somersby, near Horncastle, in Lincolnshire, of which parish his father was the rector, on the 6th of August, 1809, the same year as his great contemporaries—Gladstone, Darwin, and Elizabeth Barrett Browning. Somersby has been described as "a pretty pastoral district of softly sloping hills and large ash trees."

Tennyson's early life was an extremely happy one; he had a beautiful home, brothers and sisters of congenial tastes, and a mother who, we are told, was "a sweet, gentle, and most imaginative woman." His first verses, written on a slate when a mere child, led to an elder brother's prophecy that he would be a poet. With this elder brother, Charles, he went to Louth Grammar School. Alfred was only eighteen years old when a Louth bookseller gave the youths £10 for a small volume of verse entitled, "Poems by Two Brothers," in which the influence of Byron is very marked. "I thought the whole world was at an end," he has said, speaking of the shock which came to him as a boy of fifteen at Byron's death. "I thought everything was over and finished for everyone—that nothing else mattered. I remember I walked out alone, and carved, 'Byron is dead!' into the sandstone." In 1828 he entered Trinity College, Cambridge, and it was here that he began that friendship with Arthur Henry Hallam, the son of the historian, which was to be of so much moment in his literary career. In his first year at college he wrote "The Lover's Tale," which was not, however, published till 1879. A little later he won the chancellor's gold medal for a poem on "Timbuctoo," which is still to be found in American editions, and which a critic in the *Athenæum* declared to indicate true poetical genius. In 1830 Tennyson published a small volume entitled, "Poems, chiefly Lyrical," the contents of which included "Lilian," "Mariana," and the "Ballad of Oriana," some of those delicate prettinesses, in fact, which have secured for him so large a number of imitators. In 1832 he issued a second volume (dated 1833) containing work of a far higher order—"The Miller's Daughter," "The May Queen," "The Palace of Art," and the "Lotos Eaters," appearing now for the first time. At the end of the same year Tennyson lost his friend Arthur Hallam, to whom he was tenderly attached. Young Hallam, who had been engaged to the poet's sister Emily, was only twenty three years old at the time of his death; but he seems to have taken all knowledge for his province, to have been a good classical scholar, and also well conversant with German and Italian literature. His literary remains show keen critical insight and much poetic power. A few stray poems in the magazines were Tennyson's only contributions to literature for some years after his friend's death, a loss which clearly affected him to a very unusual extent. "He was," says Tennyson, "as near perfection as any mortal man could be." The poet led a strange, lonely life in London during this period, in friendship with Thackeray, Carlyle, and other well-known literary men. Thackeray described him about this time as "the wisest man he had ever met." "Alfred," writes Carlyle to Emerson, "is one of the few British and foreign figures who are and remain beautiful to me—a living human soul, to whom your own soul can say, Brother! One of the finest looking men in the world. A great shock of rough, dusty-dark hair; bright, laughing, hazel eyes; massive, aquiline face, most massive, yet most delicate; of sallow-brown complexion, almost Indian-looking; clothes cynically loose, free-and-easy; smokes infinite tobacco. His voice is musically metallic—fit for loud laughter and piercing wail, and all that may lie between; speech and speculation free and plenteous; I do not meet, in these late decades, such company over a pipe! We shall see what he will grow to." In 1842 Tennyson published a reprint, in two volumes, of his earlier verses, with many additional poems, notable among these being "The Two Voices," "Morte D'Arthur," "Dora," "Lady Clare," "The Lord of Burleigh," "Break, Break," "Ulysses," "Godiva," "The Poet's Song," and "Locksley Hall." So great was the popularity of these volumes that in 1845 Sir Robert Peel offered him a pension of £200 per annum, which was accepted, but which brought down upon the poet a contemptuous satire by Lord Lytton, who, in "The New Timon," made merry over what he described as—

> "The jingling medley of purloined conceits,
> Out-babying Wordsworth and out-glittering Keats."

Tennyson retorted under the name of "Alcibiades" in the pages of *Punch*, in verses which cleverly caught the weaknesses of the dandy author of "Pelham."

> "What profits now to understand
> The merits of a spotless shirt,
> A dapper boot, a little hand,
> If half the little soul is dirt."

In 1847 "The Princess, a Medley," appeared, and in 1850 "In Memoriam," an elegy on Arthur Hallam. The year

1850 was also the date of Tennyson's marriage, and the year in which he was made Poet Laureate, a dignity to which he succeeded at Wordsworth's death. He married Miss Emily Sellwood of Horncastle, a niece of the Arctic explorer, Sir John Franklin. Tennyson's married life, unlike that of so many poets, has been one of unalloyed affection. Sir Walter Scott, referring to Dryden's unhappy differences with his wife, writes of "her who had to endure the apparently causeless fluctuation of spirits incidental to one compelled to labour incessantly in the feverish exercise of the imagination," and certainly Chaucer, Shakespeare, Milton, Byron, and other poets were very unfortunate or faulty in their married relations; not so Tennyson.

During the next four years the poet wrote little beyond his fine "Ode on the Death of the Duke of Wellington" (1852), and the one celebrating "The Charge of the Light Brigade" (1854). In 1855 he received the honorary degree of D.C.L. from Oxford University, and published "Maud." At this time he was resident at Farringford House, near Freshwater, in the Isle of Wight, between which and a secluded mansion at Aldworth, near Haslemere, in Sussex, he has of late years divided his time. In the "Memorials of Mrs. Gilchrist" (1887) there is an interesting description of the poet's house-hunting before he finally settled down in the Sussex home, which was built for him in 1867 from the design of Mr. Knowles, the editor of the *Nineteenth Century*. Tennyson's longest poem or series of poems, "The Idylls of the King," was published at intervals, the first four Idylls in 1859, others ten years later, in 1869. In the interval he had written "Tithonus" and "The Grandmother" for the *Cornhill Magazine*, and in 1864 "Enoch Arden and other Poems," the other poems including "Aylmer's Field" and "The Northern Farmer, Old Style." In 1868 Lord Beaconsfield offered Tennyson a baronetcy and Carlyle a G.C.B. Both offers were refused. In the same year the poet received a visit from Longfellow, who afterwards addressed to him a charming sonnet. It was not until 1872 that the series of Arthurian legends was completed with "Gareth and Lynette." In 1875 his drama of "Queen Mary" was published, and in the following year was produced at the Lyceum Theatre in London, with Kate Bateman in the rôle of Mary and Henry Irving in that of Philip II. of Spain. Interest in the alliance of famous poet and popular actor gave the performance a certain measure of success. Another drama, "Harold," was published in 1877, and was dedicated to the second Lord Lytton, then governor-general of India, a final peace-offering for the long forgotten literary quarrel with his father. In 1878 his ballad, "The Revenge," appeared in the *Nineteenth Century*. "Eh, he has got the grip of it!" was Carlyle's terse criticism. In 1879 died his brother, the Rev. Charles Tennyson-Turner, the companion of his earliest venture in verse. In the same year a play called "The Falcon," based upon Boccaccio's well known story, was produced at the St. James's Theatre. In 1880 the volume entitled "Ballads and Poems" was published, containing "The Northern Cobbler," a powerful plea for total abstinence, and "Rizpah," one of the most terribly dramatic of all the Laureate's writings. In 1881 another drama, "The Cup," was produced at the Lyceum, with Henry Irving and Ellen Terry in the principal parts. The poet was far less happy with his fifth drama, "The Promise of May," which was brought out at the Globe Theatre, London, in 1882. The play was generally considered by the public to associate libertinism with advanced thought, falsehood and vice with so-called heretical speculations. An age which had been taught by its most popular poet to see more faith in honest doubt than in half the creeds, was scarcely prepared for such a conclusion, and although the poet's son wrote to the papers declaring that the villain of the play was not a freethinker, nor even a radical, the condemnation was almost unanimous and the failure assured.

In 1883 the Laureate accompanied Mr. Gladstone, then prime minister, on a sea-trip in the steamship *Pembroke Castle*. At Copenhagen the travellers were visited in the vessel by the King of Denmark, the Czar and Czarina, the King and Queen of Greece, and the Princess of Wales, when Tennyson read some of his poems to the guests. At Kirkwall, on the return voyage, Mr. Gladstone and the poet were presented with the freedom of the burgh, when the premier made his well-known declaration that the fame of a poet is for all time, while that of a statesman is but for an age. It may not unnaturally be taken as an outcome of this pleasure-trip that in the following year (1884) Tennyson was made a peer, under the title of Baron Tennyson of Aldworth and Farringford. In 1886 appeared "Tiresias, and other Poems," and a second volume, "Locksley Hall Sixty Years After," which excited unusual interest because of the recantation which it appeared to make of the sentiments expressed in the first "Locksley Hall." In 1887 the Laureate published a Jubilee ode, "Carmen Sæculare," in the pages of *Macmillan's Magazine*.

It is too early as yet to estimate the place occupied by Tennyson in literature. Poe called him "the noblest poet that ever lived," but another critic, recalling the poet's description of Milton as the "God gifted organ voice of England," has contemptuously compared his work to piano-music. That he is by far the most popular of modern poets is undisputed. That position he holds by virtue of his extraordinary command of a pure and simple English, and by his power of appealing to the more elementary emotions of heart and mind. He possesses little of Browning's subtlety and analytical skill, but he is unequalled among modern writers for grace and delicacy, and now and again for fervour and passion. Swinburne has placed on record his impressions on first reading "Rizpah," and they are those of multitudes of readers: "Never since the very beginning of all poetry were the twin passions of terror and pity more divinely done into deathless words or set to more perfect and profound magnificence of music; never more inseparably fused and harmonized into more absolute and sublime identity; the poet never lived on earth whose glory would not be heightened by the attribution of this poem to his hand, and thousands of readers for centuries to come will be moved by it to trembling and to tears." It is remarkable that the poet who possesses so much dramatic talent as "Rizpah" undoubtedly displays should not be a great dramatist. His dramas, "Harold," "Mary," "Becket," and the rest, have few readers even now when their author's popularity is so limitless. There is in them little depth of insight, and Tennyson's capacity for differentiating character is not great. It must not, however, be forgotten that the historian John Richard Green asserted that with all his researches into the annals of the twelfth century, he had never arrived at so vivid a conception of the character of Henry II. and his court as was embodied in the drama of "Becket." Tennyson's lack of insight and incapacity for dealing with the intricate diversities of character is sufficiently marked in the most successful of his works, "The Idylls of the King." At first the public saw in these poems merely graceful stories told with all the beauty of language natural to so gifted a writer; but when the series of Idylls was completed, Dr. Alford, dean of Canterbury, an intimate friend of Tennyson, published a criticism, apparently inspired by the Laureate, in which he urged that they were to be considered a great connected poem, not only describing the history of the Round Table, but setting forth allegorically the struggles and the conflicts of man's soul in its warfare with sense. "One noble design," he urges, "warms and unites the whole. In Arthur's coming, his foundation of the Round Table, his struggles and disappointments, and departure, we see the conflict continually maintained between the spirit and the flesh, and in the issue we recognize the

bearing down in history, and in individual man, of pure and lofty Christian purpose by the lusts of the flesh, by the corruptions of superstition, by human passions and selfishness."

Whatever may be gained to morality by such an allegory the loss to art is considerable. To know that Guinevere, Arthur, and Lancelot are abstractions, and nothing more, is to understand why they have so little of real flesh and blood, and why the knights of Arthur's court are so much like one another. Still more serious must we consider the portraiture of women in the Idylls. Shakespeare and Goethe, Wordsworth and Shelley, idealize women, and show the high possibilities of their nature. Tennyson on the other hand has contrasted his ideal of good womanhood, Enid, with his ideal of bad womanhood, Vivien; but Enid's principal characteristic is that soulless patience under wrong, that entire lack of genuine womanly self-respect which repulses us so much in the Griselda of Boccaccio and Chaucer. And if the pathetic story of Elaine wins our sympathy we may yet compare unfavourably her attitude to Lancelot with that of Viola to the duke, in Shakespeare's "Twelfth Night."

Scarcely more commendable, from the woman's standpoint, is "The Princess," although to many men it is a summary of all wise thought on the relation of the sexes; yet written as it was at a time when attempts for the higher education of women were meeting with the scorn of the Philistines, it can hardly be said to have encouraged a valuable movement. The poem is, indeed, beautiful, and is interspersed with some of the loveliest songs in the language; it is sound, moreover, in its recognition that the Princess Ida is noble in her desire for something higher than the frivolities of her father's court, and in its acknowledgment of the potency of children in the economy of our lives; it is right also, most men will believe, in its final decision:—

"Either sex alone
Is half itself, and in true marriage lies
Nor equal, nor unequal. each fulfils
Defect in each, and always thought in thought,
Purpose in purpose, will in will they grow,
The single pure and perfect animal,
The two-cell'd heart beating, with one full stroke,
Life."

Yet on the whole the poem must be pronounced reactionary in its tendency. Tennyson indeed has frequently shown himself to be a reactionist. In "Locksley Hall" he excited the enthusiasm of the younger men of his time by his social aspirations. Doubtless there was something of Byronic insincerity, of mere platform rhetoric in the poem, yet in the main it was true and helpful, showing us a mind, saddened by disappointed love, finally realizing that though the individual suffers the race progresses:—

"Forward, forward let us range,
Let the great world spin for ever down the ringing grooves of change."

In "Locksley Hall Sixty Years After" the hero is an old man of eighty, and his view of life is different from that of his early days:—

"'Forward!' rang the voices then, and of the many mine was one;
Let us hush this cry of 'Forward!' till ten thousand years have gone."

It has been urged that this poem is dramatic and not didactic, that the poet expresses not so much his own views as those of an imaginary person, whose reaction it pleases him to portray. Yet from many sources we know that there is little in the later "Locksley Hall" inconsistent with the views of the author. In "Maud," which contains much true political wisdom, and which is in many respects the poet's greatest work, Tennyson has defined his ideal of government in a manner which shows the extent to which Carlyle has influenced him:—

"Ah God, for a man with heart, head, hand,
Like some of the simple great ones gone
For ever and ever by,
One still strong man in a blatant land;
Whatever they call him, what care I,
Aristocrat, democrat, autocrat—one
Who can rule and dare not lie."

A political disciple of Thomas Carlyle he is also to some extent a disciple in religion. Next to "Sartor Resartus," "In Memoriam" is the finest poetic expression of the transcendentalism which is usually associated with the Chelsea sage. It is also in many ways the most representative poem of the Victorian era. It is stated that when a number of well-known authors were asked to name three leading poems of the century which they would have preferred to have written, each gave "In Memoriam" the first or the second place in his list.

The poet modestly describes his poem as the

"Wild and wandering cries,
Confusions of a wasted youth,"

but it has generally been accepted by thoughtful men of the broader and more cultured Christianity of the age as a complete expression of their religious position. It does not grapple with the great problems of ethical controversy so much as it reflects the Broad Church aspect of these problems, much as Pope in his "Essay on Man" reflects the philosophy of Bolingbroke and Leibnitz. "In Memoriam" is also like Pope's "Essay," in that it has furnished an endless stock of quotations to the current conversation of the day. To discuss the religious tendencies of this remarkable work is not within the province of an encyclopaedia article; it is, however, interesting to note the fact as typical of his age, that Tennyson has banished hell from his great religious poem. He has not the deep sense of the awful wrongs, the shameful evils, the terrible tragedies of human life which the very greatest among mankind have felt. It is said of Christ in the Creed that "he descended into hell." All the greatest souls who have helped men have done likewise. They have sounded the depths of human agony and despair, felt the bitter load of shame and suffering which has been laid on the human victim, and have seen the dark places of the earth to be full of the habitations of cruelty. They have dived deeper than Tennyson into the unfathomable nature of man where the fires of passion are kindled, and where the foul thoughts are bred which ripen into crime. They are like Dante, of whom the people said when they met him in the street, "There is the man who has seen hell." Tennyson is not a Dante, full of the religious insight which belongs not to an age, but to all time, but he is nevertheless a great poet with a worthy message. And to live in the atmosphere of "In Memoriam" is to live far removed from the life of material littleness which too often surrounds us, and to dwell in a region of sweet reasonableness, of tenderness and love.

In "In Memoriam," as in the "Idylls" and in many other poems, Tennyson shows his thorough intimacy with nature. No poet who has ever lived has been more scientifically exact in his descriptions. Then his humour in the "Northern Farmer" and many familiar pieces is of a very high order, and humour is a quality which many of the world's great poets have entirely lacked. He is a many-sided artist, a writer whose work is so varied in character that were one phase of it, or several, to become obsolete, much would still remain to delight and elevate. "The Poet Laureate," said Mr. Gladstone at Kirkwall on the occasion to which we have already referred, "has written his own song on the hearts of his countrymen that can never die. Time is powerless against him."

For further biographical details see "Lord Tennyson," by H. J. Jennings (1884); "Alfred Tennyson," by Mrs. Thackeray Ritchie (*Harper's Magazine*, 1883); "Tennysoniana," by R. Herne Shepherd. For criticism see "Miscel-

lanies," by A. C. Swinburne; "Victorian Poets," by E. C. Stedman; "Living English Poets," by H. Buxton Forman; "Studies in Literature," by Edward Dowden; "Essays," by George Brimley; "Lectures, Addresses, and Literary Remains," by Rev. F. W. Robertson; "Three Great Teachers," by A. H. Japp; "Remains," by Arthur H. Hallam; "Miscellanies," by Charles Kingsley; "Poetry of the Period," by Alfred Austin; "Master Spirits of Our Age," by Robert Buchanan; "Literary Essays," by R. H. Hutton; "Lessons from my Masters," by Peter Bayne; "'Maud' Vindicated," by R. J. Mann; "Keats and Tennyson," by J. R. Lowell; and Dean Alford's critique of the "Idylls," in the *Contemporary Review* for January, 1870.

TEN'OR (Fr. *taille;* now, however, more usually *ténor*), man's higher voice, ranging from tenor *c* to *a'* in the treble stave. Some fine voices reach as far as *c''*.

The tenor voice is now yearly becoming rarer, but it was once the most common voice. This is proved by the high pitch of Greek ancient music, and also by the very name of the voice, which was called "tenor," from the fact that the main chant, or *cantus firmus*, was held (*tenutus*) by it. Above it ranged the second and the triple (treble), and below it the harmony was filled in by the bass. In fact an old division of the tenor voice is into *altus* (our alto), *medius* (the old-fashioned *mean*, our tenor), and *bassus* (our bass or rather baritone).

The tenor clef is the C clef placed upon the fourth line  and serves for tenor voices. (The tenor violin uses not the tenor but the *alto* clef.) The violoncello when playing very high upon the strings uses the tenor clef.

The tenor violin, the largest instrument of the violin family, is also called VIOLA.

TE'NOS, now **TI'NO,** a small island in the Greek Archipelago, lying to the south-east of Andros, between that island and Myconos, and forming one of the group called the Cyclades. It is about 16 miles long and from 4 to 8 broad—the area being 81 square miles. It is one of the most agreeable and fertile of the Cyclades, is well watered by springs, has an excellent climate, and produces much barley, silk, wine, figs, oranges, and honey. The domestic animals are numerous, and consist of cattle, mules, asses, sheep and goats. The mountains furnish fine marble of various colours, in the working of which the inhabitants have made themselves famous. The manufactures consist chiefly of silk stockings and gloves; and the trade in wine, oil, and brandy is extensive. The principal towns are San Nicolo, Panormos, and Oxomeria. The population is about 20,000.

TEN'REC or **TAN'REC** (Centetidæ) is a family of mammals, belonging to the order INSECTIVORA. The tenrecs are peculiar to Madagascar and the adjacent islands. In appearance they somewhat resemble a hedgehog, but the typical species do not possess the power of rolling themselves up into a ball like that animal. The body is covered with hairs more or less mixed with spines or bristles. The legs are very short, and the feet are plantigrade and provided with five toes armed with strong claws; the tail is rudimentary or wanting. The skull is elongated and without zygomatic arches.

The Common Tenrec or Tangue (*Centetes ecaudatus*) is about 16 inches long, of which nearly one-third is occupied by the head, which terminates in a long pointed muzzle. The legs are short, and the tail is altogether wanting. The ears are small. There are forty teeth, arranged as follows:—

$$I.\ \frac{3-3}{3-3};\quad \frac{1-1}{1-1};\quad pm.\ \frac{3-3}{3-3};\quad .\ \frac{3-3}{3-3}$$

The canine teeth are very large, those of the upper jaw projecting downwards. The back and sides are covered with hairs and bristles, among which are mingled flexible spines, forming a kind of crest on the nape and sides of the neck. The belly and limbs are covered with short hairs. The general colour is tawny, paler on the limbs. This species is abundant in Madagascar and some of the adjacent islands, living in mountainous districts. It is nocturnal in its habits, coming forth only at night in search of food, which consists chiefly of earthworms, but also of insects, and to some extent of fruits and roots. One half of the year, from June to December, the tenrecs pass in a state of torpidity within their burrows. During this time they are very fat, and are captured in great numbers by the natives for food, the flesh being considered a great delicacy. The female is very prolific, producing from twelve to sixteen young at a birth.

The Tendrac (*Ericulus spinosus*) is an allied species, having the body covered with strong spines. It is also distinguished by having only two incisor teeth on each side in each jaw, and by having a small tail. It closely resembles the common hedgehog in appearance, and has a similar power of rolling itself into a ball. The Sokinah (*Echinops telfairc*) is a small species, closely resembling the tendrac, but with only two premolars on each side in each jaw. It is about 5 inches long, with a short snout and a very short tail. Both these species resemble the tenrec in their habits.

TENSE. See VERB.

TEN'SION, in mechanics, the name given to the force by which a bar or string is pulled, when forming part of any system in equilibrium or in motion. Thus when a weight is supported by a string, the tension of the string is the weight which is suspended to it.

TENT (Lat. *tentorium*, from *tendere*, to stretch), a portable habitation, formed generally of cloth or skins stretched upon cords or frames, and supported by poles. Tents have always been the dwellings of nomadic tribes. The natives of the East brought them at an early period to a high state of perfection, and they are frequently mentioned in the Bible. The patriarchs were dwellers in tents, and St. Paul was a tent maker. Skins are first mentioned as a tent covering in Exodus xxvi. 14, where the tabernacle is ordered to be covered with rams' and badgers' skins. Tents of cloth made of camels' and goats' hair, like those of the Arabs of the present day, were also used. The Persian monarchs passed portions of the summer in tents in the mountains, and the custom of living in them during the hot months still prevails in the East. The Greeks encamped in tents at the siege of Troy, and the magnificence of the Persian tents and tent equipage is attested by many ancient writers. Tents were early used by the Roman armies, the first being made of skins or leather, and Hannibal's forces were provided with them when they crossed the Alps into Italy. The Roman *tabernaculum* resembled the house tent, and the *tentorium* the wedge tent of the present day. A later and more elaborate tent was called *papilio;* it was probably circular, with a conical roof, but its exact form is not known. The armies of the Crusades were provided with elaborate tents, and their Saracen antagonists were equally well furnished. Mediæval tents were sometimes of the most splendid description. The finest were very large, of the pavilion form, and divided into several apartments. Their hangings were frequently of silk and damask of many colours, and their cords and stay ropes of twisted gold.

Tents are said to have been first issued to modern armies by Louis XIV., but they were furnished only to certain privileged corps. According to Bardin, the Prussian army was the first regularly provided with them. Until near the middle of the eighteenth century there was little uniformity in their shape or quality. The earliest form in use in modern armies was probably the wedge tent, formed of a square piece of cloth over a ridge pole, and without stay ropes. A wedge tent rounded at one

end and open at the other was called a *cannonière* in the French service in the last century. The *cortine* or *courtine* was an oblong wall tent, used by officers; when furnished with a fly or second roof, it was called a *marquise* or marquee. The use of tents in the French armies was almost abandoned after the beginning of the Revolution, and during the wars of the empire even the officers were rarely provided with them. It was not until about 1830, during the Algerian War, that the *tente d'abri* or shelter tent began to be regularly furnished to troops. In the British service the use of tents was more generally adhered to after their introduction than in the continental armies. The troop tent principally used is the "bell" tent, a conical roofed round tent with a wall 1 or 2 feet high. Its diameter at the base is 14 feet and its height 10 feet, and it is intended to shelter from twelve to fifteen men. The Prussian troop tent is similar to the bell tent; but in the campaigns of 1866 and 1870 the German armies were not furnished with tents.

Invalids were occasionally treated in tents during the seventeenth and eighteenth centuries, but no organized tent hospitals, the records of which have any sanitary value, were established before the Crimean War. The enforced use of tents at Varna, made necessary by the absence of houses, first aroused attention to the subject of tent hospitals. The tent used was the hospital marquee of the British service, which is a double large pletely enveloping a smaller one, with an air space of about 18 inches between them. The inner tent is 28 feet long, 15 feet wide, and 12 feet high in the middle, with walls 5 feet high, and it has a floor-cloth of painted canvas. It will accommodate twelve or fourteen persons. The Prussian hospital tent, adopted in 1867, is house-shaped, double, supported by an iron frame, and large enough for twelve beds. In the Franco German War a small square tent, supported by a light wooden frame and having a projecting pyramidal roof, was used. It was intended for but two beds, and was specially devoted to the treatment of those suffering from contagious diseases.

TEN'TERDEN, a municipal borough of England, in the county of Kent, situated among hop gardens in the Weald, 17 miles S.S.E. of Maidstone and 55 miles from London. The sea, now 10 miles distant, formerly approached the town from the Cinque port of Rye, of which it is still a sub-port. It has a town-hall, library, and a parish church with a lofty tower, which is said to have been the cause of the Goodwin Sands, as the tale goes that it was built with stones intended for the sea wall. There are places of worship for Wesleyans, Baptists, Calvinists, and Unitarians. The woollen industry, introduced by Flemings in Edward III.'s reign, is extinct. The town is governed by four aldermen and twelve councillors, including the mayor. The population in 1881 was 3620.

TENTH, in music. See INTERVAL.

TENTHS are the tenth part of the yearly value of all ecclesiastical livings. They were formerly claimed by the Pope. When the authority of the Pope was extinguished at the Reformation, Henry VIII. transferred the revenue of the tenths to the crown, and had a new valuation of all the livings, so as to obtain the tenth of their true yearly value at that time. (36 Hen. VIII. c. 5, s. 9-11.) By royal grants under 1 Eliz. c. 19, s. 2, the Archbishop of Canterbury and the Bishop of London were exempted from tenths, and were also authorized to receive the tenths of several benefices as a compensation for certain estates which were alienated from their sees. By the 6 Anne, c. 24, all benefices were discharged from the payment of tenths which, at that time, were under the annual value of £50, except those of which the tenths had previously been granted by the crown to other parties. There are also some other special exemptions. Queen Anne gave up the revenue arising from tenths, as well as from first-fruits, which had been enjoyed by her predecessors since the Reformation, and by Act 2 and 3 of her reign, c. 11, assigned it to the augmentation of poor livings; for which purpose she erected a corporation by letters patent in 1704 to administer the funds, called the Governors of Queen Anne's Bounty. [See BOUNTY, QUEEN ANNE'S.] This Act declared that episcopal sees and livings not exempted should continue to pay in such rates and proportions only as heretofore, or according to the valuation of Henry VIII., commonly known as the "King's Books." Under the Act 1 Vict. c. 20, tenths are collected by the treasurer of the governors of Queen Anne's bounty.

TENT-PEGGING, a game for horsemen introduced into England from India in 1876, which promises to become as fashionable as Polo. The game has long been practised by the Turcomans, Afghans, and other tribes of Central Asia, as well as by the Sikhs, Marhattas, and Sindians of India. Passing so much of their time as they do on horseback, they are just the men to appreciate it and to know its value as a drill-training. They must learn to keep a good seat, to train the eye in measuring distances, to be firm in grasping the lance, yet nimble in using it, and to have a steady nerve. However difficult to play, there is but little to describe in the game. Tent-pegs, made of tiny wedges of cocoa palm, cramped with copper wire and well soaked in water, are driven slantwise into prepared holes—the upper part of the peg protruding a certain number of inches. The sport consists in the horseman catching these pegs on the point of his lance as he gallops past, and carrying them clean out of their resting places. If the aim is a good one, and he forces out the peg, he wins the game, or scores one towards his game; but there are many chances to one against his exactness in direction, angle, and force, while rushing on at full speed.

TENUIROS'TRES is a suborder of birds of the order PASSERES, characterized by their long slender bill, which is generally curved and never notched at the base. They live on insects and their larvæ, and have no song. The suborder includes the Sun-birds (Nectariniidæ), Honey-eaters (Meliphagidæ), Creepers (Certhiidæ), Tree-creepers (Dendrocolaptidæ), Nuthatches (Sittidæ), and the Cærebidæ. The term is now falling into disuse.

TEN'URE. The general nature of tenure and its origin and history in England are explained in the article FEUDAL SYSTEM. The articles COPYHOLD, DISTRESS, ESCHEAT, FEALTY, FORFEITURE, MANOR, RENT, LANDLORD AND TENANT, may also be consulted.

TEPHRO'SIA is a genus of plants belonging to the papilionaceous division of the order LEGUMINOSÆ. The species are numerous, trees, shrubs, or herbs, natives of the warmer parts of both hemispheres. The American and Asiatic species are in some measure distinguished by their properties. In the former a narcotic poison is more frequently secreted, and in the latter a colouring matter. *Tephrosia toxicaria* (the poison tephrosia) inhabits the West Indies and Guiana, and is said by Tussac to have been first brought from Africa. The whole plant affords a narcotic poison; and if the pounded leaves are thrown into water, the fish become intoxicated, and losing all power over their muscles, float about as if dead, and may be easily caught. The roots are employed as an application in some kinds of skin disease in the Mauritius. The root of *Tephrosia emarginata*, a native of South America, possesses the same properties as the *Tephrosia toxicaria*, and is also used for the purpose of poisoning fish. *Tephrosia tinctoria*, the Ceylon indigo, yields a blue colouring matter, which is used in Ceylon for the same purposes as true indigo. *Tephrosia apollinea*, a native of Egypt and Nubia, also yields a kind of indigo. Its leaves are sometimes used in the adulteration of Alexandrian senna, but may be recognized by their silky down. *Teph-*

rosia purpurea, a native of India, is used medicinally by the natives, the roots being applied pounded in the form of an ointment in cases of elephantiasis, and in the form of an infusion or decoction being used in cases of indigestion.

TEP'LITZ, TOPLITZ, or **TEPLICE,** a town in Bohemia, celebrated for its warm sulphurous springs, 47 miles N.W. of Prague, on a short branch of the railway from that city to Dresden, is situated on the Saubach, in a beautiful valley 12 miles in length and 3 in breadth, formed by the Erzgebirge and the Mittelgebirge mountains. The principal buildings are the palace, with an extensive garden and park in which are a ball-room and a pretty theatre; the Church of St. John the Baptist; the town-hall, built in 1806; and the Chapel of the Cross, outside of one of the gates. More than one-fourth of the houses are inns, and nearly all the rest are lodging-houses. Teplitz is connected by a row of handsome houses with the village of Schonau. There are seventeen springs in the town and in Schonau, each of which supplies several public and private baths distributed in different establishments. The warmth of the water is said to have increased within the last forty years from 117° to 122° Fahr., which is the present temperature of the chief spring. The medicinal effects of the hot springs of Teplitz are allowed by all physicians acquainted with them to be very beneficial in cases of suppressed gout, chronic rheumatism, diseases of the joints, contracted limbs, old wounds, obstinate cutaneous eruptions, and paralytic affections. The baths are visited by the imperial and royal families of Austria, Russia, and Prussia, some of whom have built palaces for themselves; and the invalid soldiers of their armies are often sent here and lodged in appropriate buildings. The total number of visitors in a year amounts to about 15,000; the greatest number staying at one time, in the height of the season (July and August), is about 5000. The meaning of the name of the river on which the town stands (Saubach) is "Swine Rivulet," and it was given to it in consequence of a swineherd making the discovery of the springs, to which he was led by the sagacity of one of his pigs. The resident population is about 4000.

TER'APHIM, a Hebrew name found only in the plural, and given to certain images used by the Hebrews and other Eastern nations in connection with certain magical rites. The derivation of the name is unknown, and much obscurity rests over the thing signified. The most probable opinion seems to be that the teraphim were regarded as household deities, and that they were consulted as oracles and honoured with some small amount of worship. The first mention of teraphim in the Old Testament is in connection with the flight of Jacob from Laban, on which occasion Rachel stole her father's teraphim and successfully concealed them in spite of his search (Gen. xxxi. 25-35). At a later period we find teraphim included among the gods of Micah, that were stolen by the adventurers from Dan (Judges xviii. 14-21), and Michael, the wife of David, in assisting him to escape from Saul placed an "image" (Heb. *teraphim*) in the bed to deceive the messengers. The use of the teraphim appears to have existed along with the worship of Jehovah for a very long period, but it afterwards passed away so completely that the real meaning and character of the idols are almost unknown.

TER'BORCH or **TERBURG, GERARD,** an excellent Dutch portrait painter, a Vandyck in little. He was born at Zwolle in 1608; was taught painting by his father; and after many travels in Germany, France, and Italy, was knighted by the King of Spain for his splendid "Peace of Munster" (now an ornament of our National Gallery), and settled finally at Deventer, where he became burgomaster, and where he died in 1681. Terborch excelled in conversation pieces as well as portraits, and is distinguished among the Dutch painters for having generally avoided the vulgar subjects commonly treated by them, his pictures being taken almost exclusively from the social life of the more refined classes. A lady in a white satin dress was a favourite subject with him. It is not a very noble excellence, but such as it is, the distinction of being the best painter of white satin who ever lived falls to Terborch. One glorious specimen is in the National Gallery, "The Guitar Lesson." He had a sister, Gezina, who imitated his style.

TERCE or **TIERCE,** one of the CANONICAL HOURS.

TERCEI'RA (so called because it was the third of the group to be discovered), one of the Azores, in the centre of the group, about 55 miles in circuit; is bordered by precipitous coasts, which are quite inaccessible, except at two points. The interior is mountainous, and clothed to the summit with forests of cedars and chestnuts; but at the same time well-watered and extremely fertile, producing heavy crops of grain and fruits of all sorts, particularly lemons and oranges, which form a large article of export. Vines are also extensively cultivated on the sides of the hills. It is wholly of volcanic formation. Angra do Heroismo, the capital of the Azores, is on its south coast. It has an area of 162 square miles, and a population of 50,000.

TER'EBIC ACID, an acid obtained by the action of nitric acid on oil of turpentine. It crystallizes in lustrous four sided prisms, having the formula $C_7H_{10}O_4$, and is soluble in water, alcohol, and ether. It melts at 200° C. (392° Fahr.), and at a higher temperature is decomposed into carbonic acid and pyroterebic acid ($C_6H_{10}O_2$). It is dibasic, forming neutral and acid salts, having the respective general formula $C_7H_8M_2O_4$ and $C_7H_9MO_4$; these are mostly deliquescent salts. Terebic ether, or ethyl terebic acid, $C_7H_9(C_2H_5)O_4$, is an oil, slightly soluble in water.

TEREBRAN'TIA is a suborder of insects of the order HYMENOPTERA, distinguished by having the ovipositor of the female in the form of a saw or borer, with which she makes holes in the shoots of plants, or in wood, within which to deposit her eggs. The larvæ have three pairs of thoracic legs and generally a number of abdominal prolegs. These insects both in the larval and perfect condition feed on vegetable substances. Two families are contained in this suborder—Tenthredinidæ (SAWFLY) and Uroceridæ, the tailed wasps or wood-borers, of which the typical genus is SIREX.

TERE'DO is a genus of molluscs, belonging to the order LAMELLIBRANCHIATA and family Pholadidæ. The species of this genus, known as Shipworms, differ from the PIDDOCK (Pholas) in their shells being lodged at the inner extremity of a burrow partly or entirely lined with shelly matter. The shell is globular, open in front and behind, and the valves are single, concentrically striated, and divided by a three-lobed transverse groove. The hinge margin is reflexed in front, and the cavity under the beaks, internally, is furnished with a long curved muscular process. The animal is worm-like, and the foot is formed like a sucker, and possesses a foliaceous border. As there are no plates or accessory valves to protect the dorsal margin, the animal, which always lives in wood, continues to bore deeper and deeper, and lines the holes as it proceeds with a shelly tube for its protection. The siphons are very long, united nearly to the end, with fringed orifices; and about the place where the two separate, they are provided with small calcareous bodies, called palettes or styles, which close the mouth of the tube. The species are not numerous. They are found in almost all seas living in wood, which they perforate. The burrows which they thus form are usually tortuous, and always in the direction of the grain of the wood, unless the animal meets the tube of another shipworm or a knot in the timber. These animals do great damage to ships, piers, and all submarine woodwork. In 1731-32 they made

such inroads into the piles in Holland as to cause the greatest alarm. The most effectual method of preventing their ravages is to drive into the timber short broad-headed nails, the rusting of which forms a strong coating which these molluscs cannot penetrate. Metal sheathing is also used for this purpose. The Common Shipworm (*Teredo navalis*) is generally about a foot long, but sometimes attains a length of 2½ feet. *Teredo arenaria* is a tropical species, and is over 3 feet in length and 2 inches in diameter.

TER'ENCE (*Publius Terentius Afer*, *i.e.* "Publius the African"), the dramatist, was born at Carthage 195 B.C. Early in life he was brought as a slave to Rome, and became one of the household of Publius Terentius Lucanus, a wealthy senator. Here he received an excellent education, through the kindness of his master, from whom also he received his manumission at an early age. At this time he assumed, as was usual, the name of his patron, Terentius, by which he is known to posterity. His first play, the "Andria," was brought on the stage 166 B.C. The genius of Terence soon secured him the favour and patr[illegible] of Sci[illegible] African[illegible] Min[illegible] and his friend Lælius, with other Roman nobles, who wished by every means to diffuse among their countrymen a taste for Grecian letters and civilization. Through their kindness he was enabled to travel through Greece, where he collected abundant literary treasures and materials for future dramas. He is believed to have translated 108 of Menander's comedies. Unhappily he died, while on his return to Italy, at the age of thirty-five. It was widely believed that he died of grief because his translations of Menander were lost at sea. Some said he himself died by shipwreck. In his own day the comedies of Terence, though highly valued by the more intellectual Romans, were not generally popular. The audience was not sufficiently refined to appreciate the author. While, however, Greek manners and tastes gradually made their way into the heart of Latin society, the reputation of Terence continued to increase. He is praised in the warmest terms by Julius Cæsar, Cicero, Horace, and Ovid. In modern times he has been almost equally a favourite, and many distinguished writers have borrowed from his pages. Among the rest we may enumerate Molière, Steele, and Cumberland. Terence is believed to have published only six plays, one appearing regularly every year from 166 to 161 B.C. All of these still survive, viz., the "Andria," "Hecyra," "Adelphi," "Eunuchus," "Heauton Timorumenos" (the self-tormentor, a Greek title), and "Phormio." These comedies, except the "Hecyra," are constructed with a double plot; but the action is less complex than in Plautus. Terence was not a man of inventive genius; all his plays were imitated from Greek originals, the greater part being taken from Menander. Nor did he add a single new character to the stock-in-trade with which the Athenian dramatists supplied him. But his excellencies are none the less genuine and unimpeachable. For humane and liberal feeling, for knowledge of mankind, for refined and delicate wit, and for marvellous felicity of expression and easy grace of style, his scenes must always be admired by the discerning student. One noble line of Terence, at least, is known universally:—

"Homo sum, humanum nihil a me alienum puto."

(I am a man, nothing relating to humanity is unrelated to me, therefore, as I think). He was inferior to Plautus in broad humour and creative power. Though a freedman and a foreigner, Terence is reckoned one of the standard models of pure Latinity, which may probably arise from his intimacy with the most accomplished Romans of that age. The editions of Terence are very numerous; one of the most useful is that by Dr. Giles, London, one vol. 8vo, 1837.

TER'EPHTAL'IC ACID or **INSOLINIC ACID** is obtained from the oxidation of oil of turpentine by nitric acid. Several volatile oils also yield it on oxidation, as the oils of lemon, thyme, and cajeput. It is a white crystalline powder, having the formula $C_8H_6O_4$. It is insoluble in water, alcohol, and ether. It sublimes unchanged on heating, but when heated with potash it is resolved into carbonic acid and benzene. It dissolves in the alkalies, forming crystalline salts, called terephtalates, and having the general formula $C_8H_4M_2O_4$. These salts are extremely inflammable, burning like tinder, and giving off the odour of benzene. Terephtalic ether or ethylic terephtalate, $C_8H_4(C_2H_5)_2O_4$, crystallizes in prisms insoluble in water, but soluble in alcohol and ether, and melting at 44° C. (111° Fahr.)

TERE'SA, ST., was born of the noble Cepeda family at Avila, in Old Castile, Spain, on the 28th of March, 1515. Losing her mother at the age of twelve, she gave herself up to reading tales of chivalry and to girlish coquetry, till in 1531 her father placed her in an Augustinian convent. Here the desire seized her of entering the religious life; during her illness she sought her father's leave, and, though he withheld it, was received as novice by the Carmelites of her native town, 2nd November, 1533. "Her passionate nature," to quote George Eliot's "Middlemarch," "demanded an epic life. What were many-volumed romances of chivalry and the social conquests of a brilliant girl to her? Her flame quickly burned up that light fuel, and, fed from within, soared after some illimitable satisfaction, some object which would never justify weariness, which would reconcile self-despair with the rapturous consciousness of life beyond self. She found her epos in the reform of a religious order." Yet was she long in finding it—nearly thirty years passed under the Mitigated Carmelite Rule, being chiefly marked by Teresa's frequent illnesses, her father's death 1541, her yearnings towards the world, and her perusal of the "Confessions of St. Augustine." Then came two years and a half of "intellectual visions" (1559–61), during which she conceived the notion of restoring the original severe rule of her order. Having obtained a bull from Pope Pius IV. she founded a reformed branch of the Carmelites (Barefooted Carmelites), sometimes called after her Teresians. During her life twenty-nine convents of the reformed order were established, and in the eighteenth century it counted about 2000 members in six provinces in Spain and Spanish America. She was beatified by Pope Paul V., 24th April, 1614, and canonized by Gregory XV., 22nd March, 1622, her feast being fixed on 15th October. Teresa described the internal struggles and aspirations of her heart and her frequent mystic visions in treatises and letters, which are among the most memorable documents of the mystic literature of the Roman Catholic Church, while their excellence of language and style has secured for them a place in the classic literature of Spain. Five of them are extant:—"Discurso ó relacion de su vida," written in 1562; "El camino de la perfeccion," prepared in 1563 as a guide for the nuns of her reformed order; "El libro de las fundaciones," an account of the convents founded by her; "El castillo interior, ó las moradas," written in 1577, and the most celebrated of her mystic works, in which she portrays in glowing colours the gradual progress of the soul to the seventh heaven, the celestial castle of Christ, her spouse; and "Santos conceptos de amor de Dios," the original of which she burned in obedience to her confessor, but which has been preserved from a copy taken by one of the nuns. The original manuscripts of the first four works are preserved in the library of the Escurial. The first complete edition appeared at Salamanca in 1587, and a recent one, edited by Ochoa, at Paris in 1847 ("Tesoro de las obras místicas de Santa Teresa de Jesus"). A collection of letters of St. Teresa, addressed to different

persons, was published at Saragossa in 1658. The Abbé Migne edited a complete collection of her works in French (four vols., Paris, 1840–46), and they have been translated into most other European languages. A French translation from the original manuscripts was published by Père Marcel Bouix (three vols. 8vo, Le Mans, 1852–56). Among the many lives of St. Teresa are those of Ribera (Salamanca, 1590; French by Père Bouix, Paris, 1865), the Bollandist Vandermoere (Brussels, 1845), and Maria Trench (London, 1875). St. Teresa is the only woman on whom has been conferred the title of "Doctor of the Church."

TE'REUS. See PHILOMELA.

TERM. The law terms formerly were those portions of the year during which the courts of Common Law sat for the despatch of business. They were four in number, and were called Hilary, Easter, Trinity, and Michaelmas terms, taking their names from those festivals of the church which immediately preceded the commencement of each. By the Judicature Act of 1873 the division of the year into terms was abolished, *sittings* called after the old names being substituted. The High Court of Justice and the Court of Appeal, and the judges thereof, were also empowered to sit and act at any time and place during and after term, and it was also provided that sittings for the trial by jury of causes in London and Middlesex were to be held continuously throughout the year, so far as practicable, and subject to vacations.

TERM, in algebra. A *simple term* in an algebraical expression means all that involves multiplication, division, and extraction of roots, without addition or subtraction. Thus in the expression

$$a^2b^3x^2 - 2abx^3 + \sqrt{ab} \, . \, x^4,$$

the terms are $a^2b^3x^2$, $2abx^3$, and $\sqrt{ab} \, . \, x^4$.

TER'MAGANT, the English name of an old Saracen idol according to the Crusaders. Probably a modification of *Trivagant, i.e.* the moon, who wanders in the triple form of Selênê in heaven, Artemis on earth, and Persephonê in the under world. The termagant of the Crusaders was far more probably a Magian idol than a Saracen one, but our forefathers were not nice in such matters. In Ariosto, Ferran "blasphemes his Mahound (Mohammed) and Termagant" ("Orlando Furioso," xii. 59), and the Sultan in our old ballad of "Syr Guy" cries out—

> "So helpe me, Mahoune of night,
> And Termagaunt, my God so bright."

Termagant was represented in long Eastern robes, and bellowed and raved through his part with violent voice and gesture; "outdoing Termagant" was proverbial for a ranting actor, as we know from Shakespeare ("Hamlet," iii. 2). A curious result followed; the old idol's name has become the name for a virago, a shrill-voiced bully in petticoats. In Shakespeare's time termagant was still male. See 1 "Henry IV.," Act v. 4, where the term "hot termagant Scot" is applied to Douglas.

TER'MINABLE ANNUITIES are for various periods, but not so long as the so-called Long Annuities, which are usually for ninety-nine years. The government sells them for a lump sum, and they are used as a quick and convenient way of reducing the National Debt. [See SINKING FUND.] Life insurance offices issue them payable by monthly or yearly premiums from youth until the agreed time in old age, when the annuity begins, and is terminable only by death.

TERMINA'LIA. See MYROBALAN.

TER'MINUS, a Roman deity, whose worship was said to have been introduced by King Numa Pompilius, when he ordered the fields of the citizens to be separated from one another, and the boundaries to be marked by stones, which were to be considered as sacred to Terminus (probably Jupiter in the character of protector of boundaries). The *Terminalia*, or festival of Terminus, was celebrated at Rome annually on the 23rd of February. Besides the private Terminalia, there were the public Terminalia, which were solemnized in a similar manner by the whole people on the boundary of the Ager Romanus (Ovid., "Fast." ii. 679, &c.)

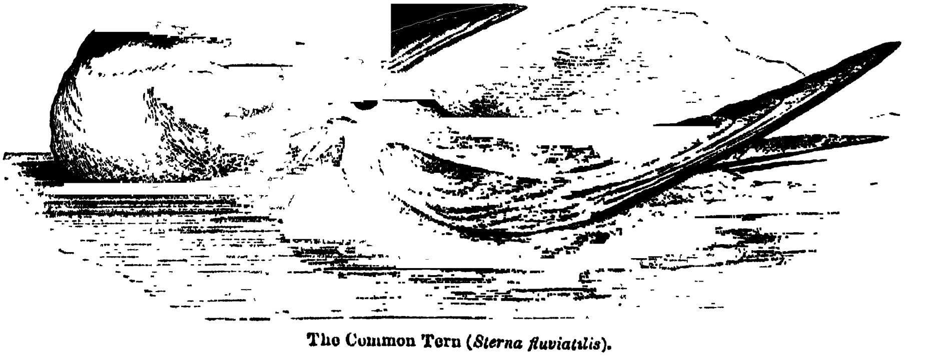
TER'MINUS signifies, in sculpture and architecture, a pillar statue, that is, either a half statue or bust, not placed upon, but incorporated with and as it were immediately springing out of the square pillar which serves as its pedestal. If they be mere busts, figures of this kind are usually distinguished by the name of Hermæ; and busts which, instead of having a circular moulded base, resemble the upper part of a terminus, are called terminal busts.

In architectural design *Termini* are employed in lieu of Caryatides, not however as insulated pillars, but as pilasters forming a small order or attic, or a decoration to gateways, doors, &c. They frequently occur in the Renaissance and Elizabethan styles.

Terminus is also now used to signify the buildings for offices, &c., at the extremity of a railway, whereas those erected at intervals along its course are called *Stations*.

TER'MITES. See ANT.

TERN (Sterninæ) is a subfamily of birds, belonging to the family Laridæ or Gulls. The terns are distinguished from the true GULLS (Larinæ) by their long, straight and pointed bill, very short slender legs, very long pointed wings,



The Common Tern (*Sterna fluviatilis*).

and forked tail. From their general appearance, small size, and swift graceful flight they are often called sea-swallows. They are generally found on or near the sea-shore, and after a severe storm may be met with on inland lakes and rivers at some distance from the sea. Their food consists of small fishes, crustaceans, and insects. They flit incessantly with easy rapid motions over the surface of the water, into which they dip ever and again to catch their prey. They also

swim, but never dive. The female lays from one to four eggs in a slight hollow in the sand or on the ledges of rocks, without any nest, and the young are tended with great care and courage by the parent birds. The species are numerous, and found in both hemispheres, those inhabiting temperate regions migrating to warmer climes for the winter.

The Common Tern (*Sterna fluviatilis*) is a very beautiful bird of a slender and graceful form, with long wings crossing above the forked tail, of which the lateral feathers run out into very long and acute points. The top of the head is black, the back and wings are pale gray, the whole lower surface white, and the bill and feet coral-red. The total length of the bird is about 14 inches. This species inhabits the coasts of Europe, Asia, and Africa: it arrives on our coasts in May, and leaves us between August and October. Its food consists of small fish, and although chiefly seen about the sea, it will not unfrequently advance far inland along the course of large rivers, and even sometimes take up its abode upon a lake. The nest of this species is usually made upon the ground in a marshy place, and contains usually three eggs. The Common Tern of North America (*Sterna wilsoni*) is probably identical with this species.

The Caspian Tern (*Sterna caspia*) is a much larger species, 19 to 21 inches long, and 51 inches in expanse of wing. The back and the wings are pale bluish-ash, the top of the head black, with a greenish gloss, the lower surface white, the stout bill vermilion, and the legs and feet black; the tail is short and not much forked. This species is a summer visitor to Britain, and is found throughout Europe, and also in Africa and North America. The Arctic Tern (*Sterna macrura*), another British summer visitor, extends very far north, being found breeding on the shores of the Arctic seas in both hemispheres. It resembles in size and colour the common species, but has longer wings and tail, and the lower surface is a leaden gray instead of white.

The Sandwich Tern (*Sterna cantica*) is a regular summer visitor to Britain, though, like the last species, it does not breed in any great abundance in this country. It takes its common name from Sandwich in Kent, where it was first obtained in England. It is about 15 inches long, with the back and wings a pearl gray, the tail white, the under surface white, often suffused with salmon colour, the legs black, and the bill black at the base, yellow at the tip. The Roseate Tern (*Sterna dougalli*) is a beautiful bird, of slender build, with short wings, and the under surface tinted with a delicate rose colour; it breeds only in a few storm-beaten islands in Britain. It is a southern form, and is more common in America. The Lesser Tern (*Sterna minuta*) is the smallest of the British species, measuring only a little over 8 inches. It is common in the Baltic, and breeds in tolerable abundance on some parts of our coasts. It is distinguished by the colour of its legs and bill, which are orange, the latter being tipped with black. The Black tern (*Hydrochelidon nigra*) is distinguished from the foregoing species by its shorter bill, short and slightly forked tail, and less webbed feet. This species is common in Europe, and formerly bred in Britain, but is now only known on migration in this country. It goes further inland than most of the other species, and is observed every year on the upper reaches of the Thames. It is about 10 inches in length, and has the lower surface leaden gray. It feeds chiefly on insects, such as beetles, dragon-flies, &c. Several other species of terns visit this country on migration.

TER'NI (*Interamna*), a town of Central Italy, in the province of Perugia, is 49 miles N.N.E. of Rome. It was the birthplace of the historian Tacitus, and of the emperors Florian and Tacitus; and among its remains of antiquity are the vaults of an amphitheatre. The modern town has a cathedral with some fine paintings, a theatre, a bathing establishment, &c. The population of the commune is 15,000, who carry on manufactures of iron and woollen and silk goods. About 5 miles above the city are the celebrated artificial cascades, 850 feet long (for drainage purposes), known as the Falls of Velino.

TERN'STRŒMIA'CEÆ, an order of dicotyledonous plants belonging to the group POLYPETALÆ, cohort Guttiferales. See BOTANY.

The species are trees or shrubs chiefly confined to the tropics of America and Asia. The leaves are alternate. simple, coriaceous, or membranous, entire or toothed. The flowers are hemaphrodite, regular, axillary, solitary, or fascicled. They have five imbricated sepals, rarely four to nine; the petals are five, rarely four to nine, free or coherent at the base into a ring or short tube; the stamens are usually indefinite, hypogynous; the ovary is free, usually three to five celled, with as many styles. The fruit is either a capsule opening by valves, or fleshy or coriaceous and indehiscent. This order is divided into five tribes, Rhizoboleæ, Ternstrœmieæ, Sauraujeæ, Gordonieæ, and Bonnetieæ. The most important economically is Gordonieæ, which contains the genus Thea, to which the tea-plant belongs, the genus Camellia, cultivated for the beauty of its flowers, and for the oil furnished by the seeds of some species, and the genus Gordonia, the species of which are astringent, and are used in tanning leather. Caryocar, one of the Rhizoboleæ, furnishes the butter-nuts or saouari nuts of commerce. Some of the species of the order are mucilaginous and emollient.

TERPAN'DROS (*Terpander*), of Lesbos, is commonly regarded as the founder of ancient Greek music. Some doubt exists as to the exact epoch at which he flourished; but since he is said by the best authorities to have been prior to Archilochos and contemporary with Midas, we may reasonably place him about 700 B.C. or a little later. If not the founder, he was at least the systematizer and regulator of Greek music, and he seems to have successfully blended the Asiatic with the native modes of harmony. He is said to have been the first who set to music the poetry of Homer, and to have been the inventor of the seven-stringed lyre. The latter claim seems borne out by one of the few fragments of his poetry still extant, where he says

"We, who no longer love the sound of the four-stringed lyres,
Loudly sing new hymns to the seven strings of the phorminx."

TERPSICH'ORE, the muse of choral song and dance, these two elements being inextricably intertwined in the ancient Greek "chorus." We now think of Terpsichore rather as the muse of dancing than of choral song. She was one of the nine muses.

TER'RA-COT'TA, baked clay or burnt earth, frequently used at an early period for the architectural decoration of a building. Many statues of the deities, bassi rilievi lamps, vessels, &c., were also formed of this material; and in modern times it has been much used for architectural decorations. It consists of potter's clay and fine white sand, as that from Reigate, with pulverized potsherds.

TERRA DI LAVORO. See LAVORO, TERRA DI.

TERRACI'NA, a seaport town in Italy, at the south-east extremity of the Pontine Marshes, midway between Rome and Naples, with a population of 7000. The old town, which is built on the site of the ancient *Anxur*, rises in the form of an amphitheatre on the slope of a calcareous rock, leaving but a narrow strip of land between it and the sea, along which runs the high road from Rome to Naples in the track of the ancient Via Appia. The old harbour, which was restored by the Emperor Antoninus, has been long since filled up, but remains of the mole still exist. The old town is an assemblage of poor-looking houses, perched one above another, surrounded and overtopped by white cliffs, which are seen from afar (Horace, "Sat." I., i. 5), and are intermingled with myrtle, orange, and palm trees, and with plants of aloes and cactus. Above all rises the

cathedral with its lofty steeple; an elegant palace built by Pius VI.; the remains of the palace of Theodoric, king of the Goths, which is a structure of the fifth century, situated on the summit of the hill, and about 600 feet above the sea; and an old castle raised in the middle ages.

TER'RAPIN is the name commonly applied to species of fresh-water chelonians belonging to the family Emydidæ. [See CHELONIA.] The terrapins form an intermediate group between the marine forms, the TURTLES (Cheloniidæ) and the land TORTOISES (Testudinidæ). The limbs are more slender than in the tortoises, and the feet are furnished with distinct clawed toes, which are united at their base by a flexible web. The body is protected by a well-developed carapace, which is more or less flattened, and within which the cylindrical neck can be completely retracted. The head is conical, and the jaws are furnished with a strong horny beak, which is sometimes dentated; the eyes are large and placed laterally. The species inhabit marshes, ponds, and rivers, but spend a large portion of their time upon land, some being almost completely terrestrial. They are good swimmers, and move tolerably rapidly upon land. They feed upon small reptiles, fishes, insects, and other aquatic animals, some preying upon small mammals and birds; vegetable matters also form a portion of the food of some. The species are numerous, natives of the tropical and warmer parts of both hemispheres, being particularly abundant in North America.

The European Terrapin (*Emys europæa*) is found in the south of France, Spain, Italy, and other parts of Southern Europe. It is a small species; the carapace is rather flat, brownish-black, with a few small yellow spots, and measures about 8 inches long and 5 broad. This species inhabits marshes and stagnant water principally, and feeds on small fishes, worms, and insects, and occasionally on vegetable substances. It hibernates, burying itself in the mud during the winter. It is occasionally made an article of food. The Yellow-bellied Terrapin (*Emys serrata*) is common in the United States of America, from Virginia to Georgia. It is about 12 inches long, 7½ inches broad, and 11 inches high. The carapace is rounded, and deeply serrated behind; it is blackish-brown, with radiating yellow lines and marks. It lives in stagnant waters and pools, and is eaten by man. The Florida Terrapin (*Emys floridana*), a native of the Southern States of the Union, is found in lakes and rivers. It is a large species, being 15 inches long and 10 inches wide. The flesh is highly esteemed. The Chicken Terrapin (*Emys reticulata*), found from North Carolina and Georgia to Louisiana, is a smaller species distinguished by the length of its neck. It is often brought to market, and is the most esteemed of the terrapins for food. The Thurgi (*Emys thurgi*) is a large species from the Ganges, over 22 inches in length. Several other species of Emys are found in India, some being used for food; and others are known from Japan and Palestine. The Caspian Terrapin (*Clemmys caspica*), belonging to a nearly allied genus, is found in Europe and Western Asia.

The Box Tortoise (*Cistudo carolina*), common throughout the United States, is remarkable for its terrestrial habits, inhabiting pine forests and mountainous districts, and seldom if ever going near the water. It is a small species, about 5 inches long, and 4 inches broad. The Alligator Terrapin or Snapping Turtle (*Chelydra serpentina*) is another common species in the United States, where it is esteemed as food. It has a small carapace, but the head is plated, and the jaws are armed with a strong hooked beak. It is common in pools and rivers, living at the bottom of the water, and feeding on fishes, reptiles, &c. It is very voracious and fierce. It attains a large size, measuring from 2 to as much as 4 feet in length.

The family Chelydidæ, which may be briefly noticed here, is distinguished from the true terrapins by having the neck long and broad, not retractile within the carapace; in repose it is bent under the side of the overhanging carapace. The species agree generally in their habits with the terrapins. The best known is the Matamata (*Chelys fimbriata*), inhabiting rivers and pools in Guiana and Brazil. It is a large species, about 2 feet 3 inches in length, and the carapace, which is oval and elevated, does not cover the body completely. The neck is about 7 inches long, and remarkably thick and flat, fringed on each side and underneath with a number of membranous appendages. The head is large and flat, and bears a number of similar barbel-like appendages; the nostrils are produced into a proboscis. It swims well, and feeds on small birds, fishes, &c.

TERRE HAUTE, a flourishing town of Indiana, in the United States, situated on an elevated plain on the east bank of the Wabash River, 73 miles W.S.W. of Indianapolis. The streets are broad and regular, and the town has some important iron works, the largest distillery in the States, and some woollen mills. The chief buildings are the city hall, market-house, opera house, Dowling's hall, and several churches. The population in 1880 was 26,040.

TERRES'TRIAL MAGNETISM. The magnetic power of the earth influences artificial magnets in a directive manner; that is, it regulates the direction in which those magnets shall point. At different places its influence is differently exerted. The magnetic elements of any particular locality are—the variation or declination of the needle (that is, its direction as compared with the horizontal), its inclination or dip (that is, its direction as compared with a vertical line); and its intensity (that is, the force or power which retains it in these positions). To determine these elements at certain known points is the object of magnetic charts.

On these charts the points at which the declination, and those where the inclination, dip, and intensity correspond, are connected by lines; lines of equal declination being called isogonic, those of equal dip isoclinic, and those of equal intensity isodynamic. The lines converge in the north of North America at a point which is known as the North Magnetic Pole, discovered by Sir James Ross in 1831; and in Southern Australia, at a point indicated by Gauss as the South Magnetic Pole. For further particulars the reader is referred to the articles MAGNET and MAGNETISM.

TERRES'TRIAL TEMPERATURE. This subject was first investigated with any degree of fullness by the philosopher Humboldt, to whose genius and devotion the world of science has been so largely indebted; and he it was who suggested the representation of heat-distribution over the globe by ISOTHERMAL LINES, that is, by lines drawn through all places enjoying the same mean annual temperature. See also HEAT OF THE EARTH.

TER'RIER is a small kind of DOG remarkable for the eagerness and courage with which it goes to earth, and attacks all those quadrupeds which come under the gamekeeper's denomination of *vermin*, from the fox to the rat. There are two well-marked varieties of terriers, the English and the Scotch. The English terrier has short smooth hair, usually black and tan in colour. The body is slender and well proportioned, the muzzle pointed, the forehead high, the ears pointed and slightly turned down, and the eyes bright and prominent. In the fox terrier, which is a variety of this, white is the predominant colour. The Scotch terrier is covered even on the face with long rough shaggy hair. The form is less graceful than that of the English terrier, the head being larger, with a shorter, fuller muzzle, and the legs are shorter and stouter. The colours of the pure breed are black and fawn. This is probably the oldest and purest breed of terrier. It is remarkable for intelligence and fidelity. The Skye terrier and the Dandie Dinmont are varieties of the Scotch terrier. The bull terrier is a cross between the bull-dog and the terrier.

TERROR is the agony of apprehension. It is quite distinct from the agony of pain, and as a rule is more depressing. Its power to prostrate the nervous energy is most remarkable; the muscles drop, the sphincters relax, the lips hang loose and tremble, and the knees give way. The digestion ceases, the intestines are disordered, the circulation is either hurried to fever or retarded to deadly pallor, the skin is covered with a cold sweat, and the breathing is difficult and slow. The nursing mother's milk is soured in her bosom. But certain specific muscles are, on the contrary, excited to spasm; the eyes are opened to a wide stare by the great muscles of the forehead being contracted, the voice is raised to a cry, the nostrils dilate, the limbs prepare for violent exertion, flight, or struggle.

The depressing terror of superstition is happily now almost absent from cultivated minds, and the higher forms of religion free the believer from the almost equally enervating fear of death.

TERROR, REIGN OF. See REIGN OF TERROR.

TER'TIARIES (Fr. *tertiaire*, from Lat. *tertiarius*, containing a third part), men or women belonging to the "third order" in any one of the monastic orders. The Tertiaries, without living in cloistered communities, bind themselves by simple vows to certain prayers and observances of the order. Such an organization of secular persons occurs for the first time in the history of the Premonstratensians, and another was connected with the order of the Templars. But it did not become generally known until Francis of Assisi, after founding the order of the Franciscans (the first order) and the order of the Poor Clares (second order), founded a third one for the numerous laymen who wished to conform themselves to the mode of life of the Franciscans as much as secular occupations would permit. When their number increased, many of them resolved to adopt the common life, and thus the third regular order of Franciscans arose. The example of the Franciscans was followed by the Dominicans, Augustinians, Carmelites, Servites, and other orders, all which have connected with them both Tertiaries living in the world, and regular Tertiaries living in common.

TERTIARY PERIOD. See CAINOZOIC EPOCH.

TERTUL'LIAN (*Quintus Septimius Florens Tertullianus*), a distinguished father of the Latin Church, was the son of a Roman centurion of proconsular rank at Carthage. His birth took place about 160. He was educated for the legal profession, but he became a convert to Christianity, and was ordained a presbyter in the church of Carthage, where he usually exercised his functions, though he visited and resided at Rome also. About 200, when he arrived at middle life, he embraced the tenets of the Montanists [see MONTANISM], which he defended with zeal and ability. Why he left the orthodox church is not certainly known. The treatment he received from the Roman clergy probably contributed to his departure from the dominant faith, much more than disappointed ambition at not being chosen bishop. It is certain that he came into personal collision with the clergy while at Rome, and that they treated him badly, out of envy and dislike. He lived to a great age, and died about 240. His works show that he was married—one of his tracts containing an address to his wife. The accounts of his life which we possess are very scanty; and were it not for Jerome's notice of him, we should hardly have known anything whatever. This father says that Cyprian was accustomed to read some parts of his writings daily, and in calling for his books used to say—"Da magistrum" (Give me the master). The character of Tertullian was gloomy, severe, and fiery. He wrote with force and animation; but his genius was wild and unchastened. He had great erudition and legal knowledge. His writings also display acuteness and depth of feeling, with a vivid conception of the ideal. But he lacked judgment. His piety, indeed, was fervent and active, but austere and rigid. His diction is vigorous, but the style is so concise that it is harsh and difficult. With a rough energy, it disdains polish. There is no doubt, however, that he had uncommon power of intellect and emotion. Hence he succeeded in achieving for Christianity a literature of a peculiar character in the Punic-Latin dialect, and even in impressing a type upon Latin theology which it never lost. His "Apologeticus" has been called the first plea for religious liberty in Christian literature, and is one of the best defences of Christianity and the Christians against their pagan adversaries. In his treatise "On the Testimony of the Soul" he unfolds the profound thought that Christianity is grounded in the nature of man, and meets its deepest wants. He led the way in ecclesiastical anthropology and soteriology, was the teacher of Cyprian, and the forerunner of Augustine. Among his controversial works are his books "Against the Gentiles," "Against the Jews," "Against Hermogenes" (showing that matter is not eternal, but created by God), "Against the Valentinians," "On the Prescription of Heretics" (asserting vehemently that no doctrine contrary to the received faith had a claim to toleration from the church, or to appeal to the Scriptures, and contradicting the principles of his "Apology"), "Against Marcion," "Against Praxeas," "On the Soul," "On Baptism," "On the Flesh of Christ," and "On the Resurrection of the Body," in all of which he opposes growing errors, and seeks to show what is the true doctrine of the church. Among his practical works belong the book "On Penance;" that "On Prayer," which explains the Lord's prayer; "On Patience;" "To the Martyrs;" "On Theatrical Shows;" "On Idolatry," a casuistical discussion of the degree to which idol worship may be tolerated by Christians; "On the Dress of Women," and on the "Veiling of Virgins," which teach that modesty and the hiding of the features are proper for women in the house of God; and the book "To his Wife," in which he proclaims his aversion to second marriage. His specially Montanist works are the "Exhortation to Chastity" and "On Monogamy," in which he carries to absolute prohibition the theory of the book "To his Wife;" "On Chastity," which denies that those who are guilty of gross sins can be absolved; "On Repentance;" "On Fasting;" "On the Soldier's Crown;" and "On Flight," which insists that Christians ought not to flee from persecutions. The life of Tertullian has been written by Jerome in the early church, and in modern times by Neander (Antignosticus, Berlin, 1825) and Hesselberg (Dorpat, 1848). Numerous editions of his works have been published.

TER'ZA RI'MA, a rhyme scheme or mode of versification which if not invented by Dante for his *Divina Commedia*, was at all events therein brought to perfection by him such as has never since been attained. It is part of Dante's plan to represent his whole poem as bound together. To sing of hell, purgatory, and heaven in formal stanzas is horrible to the imagination, and blank verse did not exist in Dante's time, nor has it ever commended itself in Italian as the highest medium of poetry. Dante's line is of eleven syllables:—

"Non ragionam di lor, ma guarda e passa."

(It will be seen that *-gio* and *-da e*, which with us would be two syllables, the genius of the Italian language permits to fuse together into one.) These lines he weaves together into a chain in a way we may indicate thus, representing rhyming lines by the same letter:—

a, b, a, b, c, b, c, d, c, d, e, d, e, f, e, &c.,

We can separate the lines into three thus, *aba*, *bcb*, *cdc*, *ded*, *efe*, &c., each fresh pair of rhymes inclosing between them one line which rhymes to the pair of the following tercet. An example will make the structure clearer. It is drawn from Cayley's not very good imitative translation ("Purga-

torio," xxviii.), where Dante beholds Matilda by the river Lethe:—

> "As pointing downwards, and to one another,
>   Her feet a lady bendeth in the dance,
> And barely setteth one before the other;
> Thus on the scarlet and the saffron glance
>   Of flower, with motion maidenlike she bent
> Her modest eyelids, drooping and askance;
> And there she gave my wishes their content;
>   Approaching, so that her sweet melodies
> Arrived upon mine ear with what they meant.
> When first she came amongst the blades that rise
>   All wet and drooping from the goodly river,
> She graced me by the lifting of her eyes."

From 1884 to 1886 no less than three translations of Dante in terza rima appeared in England, by Sibbald, Minchin, and Plumptre respectively; and in the next year was published a fourth and still better translation of Dante, also in terza rima, by F. K. H. Hazelford (London, 1887).

TERZETTO, a Trio on a smaller scale.

TES'SELATED PAVEMENT, a coarse mosaic work done with small cubical bricks or *tesseræ*, and very usual as a flooring to Roman houses. A modification of it with large square encaustic tiles has become a favourite pavement for halls, corridors, aisles of churches, &c.

TES'SERA, a small cube or square resembling our dice, which was used by the ancients for various purposes, and formed of different materials, as marble, precious stones, ivory, glass, wood, or mother-of-pearl. Such small tesseræ of different colours were used to form the mosaic floors or pavements in houses, which were hence called *tesselata pavimenta*. The same kinds of cubes were used by the ancients for dice in games of hazard as in our times.

TES'SIN. See Ticino.

TEST ACT. This famous Act, passed in 1673 (25 Car. II. c. 2), compelled all holders of office to take the sacrament in accordance with the ceremony of the English Church, and to make a declaration against transubstantiation. This was an extension of the Corporation Act of twelve years before, which had applied a similar test to holders of municipal offices only; but whereas the Corporation Act was aimed by the court at the Presbyterians, the Test Act was aimed by the House of Commons at the Roman Catholics.

TES'TER, a canopy overhead (Old Fr. *teste*, head): hence an old-fashioned ceiled bed, or "four-post bedstead."

Tester or testoon was also the name given to a silver coin bearing the head (*teste*) of the king in profile, in lieu of the full face used since Norman times. The tester of Henry VII. was the shilling [see Plate IV., Coins], and later on the sixpence of Henry VIII. bore the same name. French testers were struck under Louis XII., in 1513, and Scotch under Mary, in 1559.

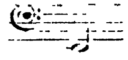
TESTOON or **TESTO** is the tenth part of the Portuguese milreis. It is a silver coin of 2·5 grammes, ·916 fine, worth $4\frac{3}{4}d$. Coins of five and two testoons and half-testoons are also struck.

Testoon was another name for the English Tester, which began with Henry VII.

TESTS, CHEMICAL, or Chemical Re-agents, are those substances which are employed to detect the presence of other bodies, by admixture with which they are known to produce certain changes in appearance and properties.

TESTU'DO (Lat., a tortoise), among the Romans a large wooden tower, which moved on wheels, and was so called from its presumed strength. It was covered with bullocks' hides, and was intended to protect the soldiers during their attack on the walls of a town. The term was also applied to a peculiar form of battle, which was intended as a defence in sieges against the missiles of the enemy. The soldiers, with their shields over their heads, presented the appearance of a sloping roof, or tortoise's back; the first rank standing upright, the next ranks stooping lower and lower, and the last one kneeling. Among the Roman poets the term was also applied to the ancient lyre, because it was originally made of the hollow shell of the sea-tortoise. See Tortoises.

TET'ANUS is an apparently rigid condition of muscle due to a succession of nervous impulses or of shocks from an induction-coil. A single shock will cause the muscle to contract, and in contracting to swell; a second shock applied while the first is operating will produce a curve of swell starting from the first; a third quickly added shock piles on yet another curve, but the addition is not so great; and with successive shocks the addition becomes successively less until at last no addition whatever is made, but the muscle is maintained at its greatest thickness and greatest contraction. It used to be thought that it was rigid, but delicate instruments now show it to be in rapid vibration. Tetanus may be produced by nerve-force violently exerted just as well as by the artificial method of repeated induction shocks. In either case it is a vibratory movement; the apparently rigid and firm muscular mass is really the subject of a whole series of vibrations, a series namely of simple spasms. It can be readily understood therefore that tetanized muscle gives forth a sound, since sound is the result of any kind of periodic vibration. This muscular sound can be heard by listening with a stethoscope to a biceps strongly contracted, or by stopping the ears and listening to the contractions of one's own masseter and temporal muscles. The pitch of the sound depends of course on the rate of vibration; and if the tetanus is artificially induced it is governed by the rapidity of the successive shocks. In natural tetanus the continued contraction of muscle by the effort of the will or by involuntary nervous action, the sound is always the same within one or two vibrations, namely, 19·5 a second. The ear cannot hear so slow a vibration as this; the sound actually heard is therefore the first partial, the octave to the prime, namely, thirty-nine vibrations per second:—



8va bassa.

This is the note EE♭ an octave below the note in the figure, and a major Sixth below the lowest note of the violoncello, or an augmented Third below the lowest note of the ordinary (three-stringed) contrabasso.

TET'ANUS or **LOCK-JAW** is a spasmodic disease characterized by painful, involuntary, and protracted contraction (*tetanus*) of a greater or smaller number of the voluntary muscles. It may arise spontaneously or as the result of exposure to climatic change, in which case it is called *idiopathic* tetanus, or it may come on as a result of a wound or injury, in which case it is known as *traumatic* tetanus. More rarely it may be a disease of infancy, the condition being known as *trismus nascentium*. In Great Britain the two latter forms of the disease are rare, nearly all the cases observed being traumatic. Tetanus is liable to follow injury of any kind to any part of the body, setting in sometimes as severely from an apparently trivial scratch or wound as from a severe surgical operation. It has been found to follow wounds of the extremities more frequently than those of the trunk, head, or neck, and penetrating wounds of the feet or hands are more liable than other injuries to be followed by this disease. It is also certain that the disease is greatly influenced by local circumstances and meteorological conditions. Wounded soldiers who are left exposed on the field after a battle often suffer severely from tetanus, and in the tropics the disease is far more frequently met with than in other parts of the world. It is seldom absent from the Indian hospitals, and in some seasons appears to prevail as an epidemic. The disease usually begins with chills and a feeling of

depression and debility, with vertigo and sleeplessness, the face meanwhile presenting a peculiarly pinched appearance. These symptoms are followed by a feeling of stiffness and uneasiness about the muscles of the neck and jaws, so that the patient often thinks he has a sore throat, stiff neck, or a slight rheumatic affection. He finds also that he is unable to separate the jaws to any distance, and more or less gradually they close, so that he is unable to open the mouth at all, a condition called *locked jaw*, which has given the disease its popular name. As the disease advances the remaining muscles of the neck, trunk, and extremities become affected, and there are internal spasms felt in the region of the stomach and diaphragm. The spasm never entirely ceases, one or more of the groups of muscles indicated being constantly rigid, but in addition to this the cramp felt is increased by terrible spasms, which last from a few seconds to five or even ten minutes, the intervals between such seizures being irregular and uncertain. In some cases all the muscles are firmly contracted, and the whole body remains stiff and straight. Ordinarily the strong extensors of the trunk and limbs are more affected than the flexor muscles, or their superior power overcomes the resistance of these latter, and during the paroxysm the body is bent into the shape of an arch, the patient resting upon his head and heels only. This constitutes *opisthotonos*. Occasionally, but more rarely, the patient is bent forward till the head and knees are almost in contact, a condition constituting *emprosthotonos*; and still more rarely there is a lateral curvature forming *pleurosthotonos*. The suffering caused by these spasms of tetanus is agonizing to endure and terrible to witness. The face of the patient becomes deadly pale, the brows being contracted, the eyes prominent and fixed, the nostrils dilated, and the corners of the mouth drawn back so as to expose the clenched teeth, the ghastly grin thus caused being known as *risus sardonicus*. The pain in the contracted muscles and in the region of the stomach is very severe, and though speech may be prevented by the contraction of the muscles of the chest and the fixed state of the jaws, the intellect is unaffected, and the patient remains painfully aware of the critical nature of his condition. When the disease is prolonged there is also much suffering from hunger, thirst, and want of sleep, so that death often ensues from exhaustion as well as from suffocation. With respect to the duration of the disease, it may be said to vary from a few hours to over a fortnight. In the greater number of cases the patients die of tetanus from the seventh to the eleventh day after the commencement of the disease. If they survive the twelfth day the prospect of recovery is favourable, and as a rule after this period the spasmodic symptoms gradually abate and ultimately disappear. A patient may generally be pronounced cured in twenty-five days after the commencement of the attack, but the affected muscles will remain sore and tender for a much longer period. As regards treatment, although several drugs have been tried, unhappily up to the present no specific has been found for the disease. Opium and Indian hemp have had many advocates, but it is found that persons suffering from tetanus can take enormous doses of these drugs without feeling their influence, and even when sufficient quantities are administered to produce a physiological effect they seem to exert but little power over the spasms. Calabar bean has also been strongly recommended, but the results following its administration are hardly satisfactory. Large doses of hydrate of chloral sometimes do good, and this drug certainly has the effect, in the majority of cases, of relieving the pain and procuring some measure of sleep. As soon as the disease has manifested itself, the patient should be put to bed, in a darkened room, and every effort should be made to keep him as quiet and undisturbed as possible. Liquid food, such as milk, milk and egg, or milk mingled with the juice of raw meat, should be given every four hours, the cheeks being opened with the fingers and the liquid allowed to trickle down between the teeth. The process of feeding, should any of the fluid run into the trachea, may give rise to spasm, but on the other hand support is absolutely necessary to enable the constitution to struggle against the disease. Where tetanus results from injury the wound should be carefully examined to see whether by chance any foreign substance may have been left in it.

TE'THYS (Gr. *Tēthys*) was, in the Greek mythology, a Titan, the daughter of Ouranos and Gaia. She became the wife of Okeanos (god of the open sea), and mother of the Okeanids and numerous river-gods. Hera, the queen of heaven, was brought up by her. An absurd confusion is sometimes made between this Titan-goddess and the "silver-footed" THETIS, a Nereid, and the mother of the hero Achilles.

TET'RACHORD, in music, is a short scale of four notes (as for instance, D, E, F, G), which is the basis of the ancient music. See the article GREEK MUSICAL SYSTEM.

The word is sometimes in modern use to signify a half-scale. Thus the major scale

C D E F | G A B C

may be considered as two tetrachords, divided by a whole tone, and in themselves precisely similar, each proceeding by "tone, tone, half-tone." The theoretical musician points out, however, that the resemblance between the two tetrachords, though perfect in equal temperament, is not perfect in just intonation. The ratios, in just intonation, are

$$\begin{array}{ccccccc|ccccccc} & \frac{9}{8} & & \frac{10}{9} & & \frac{16}{15} & & & \frac{10}{9} & & \frac{9}{8} & & \frac{16}{15} & \\ C & & D & & E & & F & G & & A & & B & & C \end{array}$$

where the positions of the major tone (9 : 8) and the minor tone (10 : 9) are seen to be reversed.

TET'RAGON (properly a four-angled figure), an infrequent term usually limited to the square.

TETRAGO'NIA is a genus of plants placed by Bentham and Hooker in the order FICOIDEÆ (or Mesembryanthemeæ). The species are herbs or undershrubs, all natives of the southern hemisphere beyond the tropics. The best known species, *Tetragonia expansa* (New Zealand spinach), is a native of New Zealand, Tasmania, and the south and west parts of Australia, growing on the seashore; it is also found in Japan and in South America, where it has perhaps been naturalized. It was introduced in England in 1772 by Sir Joseph Banks, who accompanied Cook on his first voyage round the world. In cultivation it is a half-hardy annual, resembling very nearly in taste the true spinach, and as it bears a dry warm season better than the latter plant, it proves a useful substitute. It is of a trailing habit, with numerous branches and leaves, the latter being rhomboid or ovate, thick, succulent, and deep-green in colour. It is the only cultivated species which has been introduced from New Zealand. The characters of the genus are as follows:—

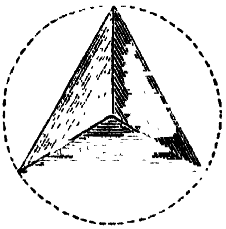
The leaves are alternate, stalked, fleshy, usually entire. The flowers are hermaphrodite, regular, axillary, with the calyx three to five lobed, fleshy, coloured within, the corolla absent, the stamens epigynous, one to five or more numerous, the ovary inferior, three to five celled. The fruit is a drupe or an angular nut, crowned by the enlarged and persisting calyx.

TETRAGONOL'EPIS is a genus of fossil fishes found in the Lias formation of Devonshire. It belongs to the order GANOIDEI and family Stylodontidæ. The body is ovate, covered with ganoid scales, and the tail is symmetrical (homocercal). The dorsal fin is long, extending to the caudal. The fins are furnished with fulcra. The jaws have several series of teeth, the outer ones being equal and styliform.

TETRAGRAM'MATON (Gr. "four letters"), a term in use among the ancients for expressing the mystic number four, because it was supposed to symbolize the Deity, that sacred name being expressed, in most languages, by four letters; as the Heb. JHVH (יהוה), the Egyptian Thouth (*Θωυθ*) and Amun, the Assyrian Adad, the Persian Soru, the Greek Zeus and Θεος, the Latin Deus or Jove, the Arabic Alla, &c. To these we may add the German Gott, the Swedish Goth, the Dutch Godt, and the Danish Godh; the Spanish Dios and the French Dieu.

TETRAHE'DRITE, or **GRAY COPPER ORE** (Ger. *Fahlerz*), is a mineral consisting essentially of a double sulphide of copper and antimony, more or less mingled with the sulphides of iron, zinc, silver, mercury, arsenic, and bismuth, and so called from its most usual crystalline form being that of the tetrahedron. It has a metallic lustre and a light or dark gray colour; and the mineral is generally somewhat brittle, the splinters being partly translucent and having a reddish tinge when viewed by transmitted light. Several varieties are recognized under distinct names. One containing much silver is known as Freibergite, and another with mercury, Schwatzite or Quecksilberfahlerz (Ger.) The mineral occurs in the mines near St. Austel, in Cornwall, and also in most of the copper-bearing veins on the Continent and in America.

TETRAHE'DRON, one of the five regular geometric solids, is a pyramid of four triangular faces.



Tetrahedron.

TETRAMÉTHYL AMMONIUM. See METHYLAMINE.

TETRAON'IDÆ is a large family of game birds (GALLINÆ). The Tetraonidæ have a short and rather broad bill, of which the upper mandible is considerably arched, compressed towards the tip, and rather obtuse at the point; the nostrils, which are placed at the base of the upper mandible, are frequently covered with feathers, or concealed by a hard scale; and the feet are rather short and moderately stout, generally scaled, but sometimes covered with somewhat hair-like feathers to the extremity of the tarsi, or even of the toes. The hind toe is small, and slightly elevated upon the back of the tarsus, which is most commonly destitute of spurs.

These birds are very generally distributed over the face of the globe, but the most typical species of the family inhabit the forests and heaths of mountainous countries. Their food consists partly of vegetable and partly of animal matters, such as seeds, fruits, and the young shoots of plants and trees under the former category, and worms and insects under the latter. Some of them are polygamous, but many pair; and in the latter, at least, both the male and the female assist in rearing the young.

This family is divided into two subfamilies, the GROUSE (Tetraoninæ) and the PARTRIDGES (Perdicinæ), distinguished by the former having the legs feathered to the toes and the nostrils covered with small feathers, while the latter have bare scaled legs and open nostrils.

TET'RARCH (Gr. *tetrarchês*, from two words, signifying "four" and "government"), a title used by the Greeks to designate the ruler of each part of a country which was divided into four parts, either on account of its occupation by different tribes, or merely as a political division. In process of time the name was applied to the rulers of different divisions of the same country, or to the chiefs of different tribes inhabiting the same country, without any reference to the number four. Under the Roman government, in the later times of the republic and under the emperors, there were several such petty princes, independent of each other, but tributary to Rome. They ranked below those other subject princes who were permitted to retain the title of king.

The principal examples of tetrarchies are those of Thessaly, which was anciently so divided, and the division was again made by Philip, the father of Alexander the Great—of Galatia, which was peopled by three Gallic tribes, each of which was divided into four tetrarchies; and of Syria, many of the petty princes of which bore the title of tetrarchs, especially some of the family of Herod the Great.

TET'RASTYLE is a term of Greek architecture, meaning a temple with four columns on the face.

TET'RYL or **BUTYL,** an alcohol radicle, first obtained by Kolbe by the electrolysis of valerianic acid. It is an oily fluid of agreeable odour, having the specific gravity 0·694. It boils at 108° C. (226° Fahr.), and is insoluble in water, but soluble in alcohol and ether. The formula is C_4H_9. The hydrate of tetryl or tetrylic alcohol ($C_4H_{10}O$) is found in fusel oil from potatoes and mangold-wurzel, and is usually produced in the fermentation of sugar. It is a colourless liquid, resembling fusel oil in odour. The specific gravity is 0·8032, the boiling point 10° C. (50° Fahr.) It is soluble in water, and forms a crystalline compound with calcium chloride. It is decomposed by potassium, hydrogen is evolved, and tetrylate of potassium (C_4H_9KO) formed. Treated with hydrochloric acid in a sealed tube, it is converted into chloride of tetryl (C_4H_9Cl), an ethereal liquid of specific gravity 0·88, and boiling at 70° C. (158° Fahr.) The bromide of tetryl (C_4H_9Br) is an oily liquid, of specific gravity 1·274, and boiling at 89° C. (192° Fahr.) The iodide of tetryl (C_4H_9I) is also a liquid, boiling at 121° C. (250° Fahr.), and having the specific gravity 1·604. Hydride of tetryl (C_4H_{10}) is found in American petroleum. It is insoluble in water, but soluble in alcohol and ether, and is a very volatile mobile liquid, having the specific gravity 0·60, and boiling about 7° C. (45° Fahr.)

Tetrylamine or butylamine ($C_4H_{11}N$ or $NH_2C_4H_9$) is the amide of tetryl. It is a colourless liquid, resembling ammonia, very soluble in water, alcohol, and ether, and boiling at 70° C. (158° Fahr.) It precipitates most of the metals, like ammonia. It is a strong base, and forms with acids crystalline salts: the formula of the hydrochlorate of tetrylamine is $C_4H_{11}NHCl$. The chloroplatinate, $2(C_4H_{11}NHCl)PtCl_4$, crystallizes in beautiful orange-yellow plates.

Tetrylene or butylene (C_4H_8) is a hydrocarbon first obtained in 1825 by Faraday from oil gas. It is a colourless oil, of ethereal odour, which boils at 0° C. (32° Fahr.), and is therefore gaseous at the ordinary temperature; it congeals at a very low temperature. It is slightly soluble in water, more soluble in alcohol, and completely soluble in ether. With chlorine it unites, forming tetrylenic chloride ($C_4H_8Cl_2$). This is a colourless oil, resembling Dutch liquid, and having the specific gravity 1·112, and boiling at 123° C. (253° Fahr.)

TETUAN', a seaport of Morocco, 40 miles south of Gibraltar, belonging to Spain, on the slope of a hill, about 4 miles from the mouth of the river Martil, in the Mediterranean. The town is fortified, and has an active trade in leather, wool, silk, cotton, and fruit. The population is about 20,000 of whom 4000 are Jews.

TET'ZEL or **TEZEL, JOHANN,** a Dominican monk, who lived about the end of the fifteenth and the beginning of the sixteenth century, was a native of Leipzig, and entered the order of the Dominicans in the Pauliner Kloster. In 1502 the Pope appointed him preacher of indulgences for Germany. He converted this office into a most lucrative traffic, and his conduct excited so much indignation, that he was condemned at Innsbruck to be sewed up in a sack and drowned, having been convicted of adultery. But the sentence was first changed into imprisonment for life, and shortly afterwards he was released at the request of Albert, archbishop of Mainz, and other ecclesiastical dignitaries. Tetzel now made a pilgrimage to Rome, where Pope Leo X. appointed him *commissarius apostolicus* in Germany, in addition to which the Archbishop of Mainz made him *inquisitor hæreticæ pravitatis.* As papal commissary he carried on his traffic in indulgences more boldly than ever. Tetzel's visit to Wittemberg in 1516 scandalized and enraged Luther, and became one of the proximate causes of the Reformation. Luther's famous theses against him were published 31st October, 1517. [See LUTHER.] Tetzel, in consequence of overacting his commission, was reproved by the legate, and was so humbled by the rebuke that he retired to his convent in Leipzig, and died broken-hearted 4th July, 1519.

TEUK'ROS (Lat. *Teucer*) was one of the Greek heroes of the siege of Troy, renowned as the best archer in the whole force. He was the half brother of Aias (Ajax), being the son of Telamon by another mother. When he returned to his aged father in Salamis, after the fall of Troy, Telamon refused to receive him, as he had left the death of Aias unavenged. Teukros found a new home in Cyprus, of which eventually he was made king by its lord, the King of Sidon; whence comes the foundation of the town of Salamis in Cyprus.

It makes a little confusion that the first King of Troy was also called Teukros. He was the son of the god Skamandros, divinity of the Trojan river of that name, by the nymph Idaia, of the Trojan mountain of that name. Hence (especially in Latin poets) the Trojans are often called *Teucri*. Dardanos married the daughter of Teukros, and succeeded him in the rule over Troy.

TEUTON'IC NATIONS. Under this general title are comprehended various nations, whose languages may be classed under the northern division of the Aryan or Indo Germanic family.

According to philologists these nations are supposed to have passed out of Asia into Europe over the Kimmerian Bosphorus, north of the Black Sea, about B.C. 680.

The name Teutoni or Teutones was first given, about B.C. 320, to a tribe long settled in the Chersonesus Cimbrica and adjacent islands, or what are now known as Holstein, Schleswig, and Denmark. Pytheas of Marseilles was the first who made this tribe known to the Greeks and Romans. The Teutones afterwards became formidable enemies to the Romans; and by the end of the second century before the Christian era, and about the commencement of the first, they invaded the south of France and the north of Italy. They were, however, defeated by C. Marius near Aquæ Sextiæ (Aix), in a great battle, in which about 100,000 of them were slain and 80,000 taken prisoners. [See MARIUS.] The Romans, when they first heard of the Teutones, thought that they were a single tribe; they did not know that it was the general name of all those nations to which they afterwards gave the vague designation of Germans. In somewhat later times these nations or confederations of tribes were known as the Franks, the Suevi, the Saxons, the Marcomanni, and the Alemanni. Tribes of the Condrusi, the Eburones, and others, who had conquered the countries on the left bank of the Rhine, were also united in a confederation, and had adopted the name of Germani, or "warlike men." This name was gradually used by the Romans to designate other nations which belonged to the Teutonic race (Tacitus, "Germ.," c. 2), and subsequently it was adopted by the English as a name for the "Deutsche," while this name, changed into Dutch, now designates the inhabitants of Holland.

The element *Teut* (from the Gothic *thiuda*, Anglo-Saxon *theod*, Old High German *diot*, populus, gens) occurs in the names of a great number of ancient Teutonic chiefs, as Teutoboech, Theodoric, and many others. It occurs also in names of places, as Teutoburger Wald and in other localities in Germany. It is said that in some of the German dialects *Teut* still signifies God, father, ruler, and so forth. The element appears, or seems to appear, in a great number of German words. The word *Teuton*, as was above remarked, is identical with *Deutsche* or *Teutsche* (in Low German *Dütsch*, in Dutch *Duitsch*, in Danish *Tysk*, in English *Dutch*), which from the remotest time has been, and is still, the general name of that part of the Teutonic nations which we now call Germans, who considered the god or hero Tuisco as their common ancestor. There are no direct proofs of the word Teuton having had this extensive meaning in the earliest German history; but this is perhaps the result of the political state of the Teutonic nations, which were originally divided into numerous tribes, each of which became separately known to the Romans. In the twelfth, eleventh, and even as early as the tenth century, when the difference between Franks and Saxons was well marked in the German Empire, these nations, each of which had its own language and laws, never objected to being called by the general name of Deutsche or Teutones.

The Teutonic nations may be described as one of the great ethnographic divisions, comprehending the inhabitants of Germany, Holland, Friesland, England, Denmark, Sweden, Norway, and Iceland. These again are divided into three great branches: 1. The High Germans, to whom belong the Teutonic inhabitants of Upper and Middle Germany, those of Switzerland, and the greater part of the Germans of Hungary; it is subdivided into the Swabian and the Franconian minor branches. 2. The Low Germans, divided into three minor branches:—The first branch contains the Frisians; the second contains the Old Saxons or Low Germans, with the Dutch, the Flemings, and the Saxons of Transylvania; and the third contains the English, the Scotch (excluding the Highlanders, who are Celtic), the greater part of the inhabitants of the United States of North America and of the British colonies. 3. The Scandinavians, to whom belong the Icelanders, the Norwegians, the Danes, and the Swedes. It has been estimated that a population of about 100,000,000 belong to the Teutonic nations.

The characteristics of the Teutonic race are light hair and blue eyes in the northern countries, and brown hair and brown or blue eyes in some of the southern countries. Their stature is generally tall, although in those provinces where the Germans are mixed with Wends, Sorabians, and Bohemians, many of the people have the broad shoulders and the short square form of the North-western Slavonians. The straight black hair of some Slavonian tribes also sometimes appears. The mixture of Germans with the South-western Slavonians, such as the Croatians, whose stature exceeds that of the Wends and Bohemians, is more difficult to be distinguished, the black straight hair and a darker complexion being almost the only indication of such a mixture. The mixture of Germans with Celts in Belgium, and in the adjoining part of France, has formed a tall race, which differs from their Teutonic neighbours only in the dark colour of their hair and their black eyes.

The Teutonic languages and dialects, living and dead,

may be classified as follows:—I. *High German*, embracing Old High German, Middle High German, Modern German, Alemannic or Swabian, and Francic. II. *Low German*, embracing Mæso-Gothic, Anglo-Saxon, Old Dutch, Old Frisian, Old Saxon, Platt Deutsch, and English. III. *Scandinavian*, embracing Icelandic or Old Norse, Norwegian, Swedish, and Danish.

TEUTON'IC KNIGHTS. The name of a famous religious order of knighthood, the members of which were anciently called the Knights of our Lady of Mount Sion, and sometimes Teutonic Knights of the Hospital of St. Mary in Jerusalem. They were so called because they consisted chiefly of Germans or Teutons. Their origin is supposed to have been about the close of the twelfth century, when the Christians, under Richard, king of England, and Philip Augustus of France, were laying siege to Acre, in the Third Crusade. During the siege some Germans of Bremen and Lübeck, moved with compassion for the wounded, made tents of the sails of their ships to serve as hospitals, and attended on the sick. According to Dean Milman these merchants were joined by the brethren of a German hospital, which had before been founded in Jerusalem, and had been permitted by the contemptuous compassion of Saladin to remain for some time in the city. In this way the idea of a military order originated, similar to those of the Templars and the Hospitallers. Henry Walpot was the first master of the new order, and in the course of time it became so powerful that in 1230, Conrad, duke of Mazovia and Cujavia (regent for Boleslas V., king of Poland), offered to its members for a term of years the provinces of Culm and Livonia, with all the lands they could recover from the savage Rutheni, who harassed him with their continual incursions. The knights, whose object was the subjugation and conversion to the Christian faith of the heathen nations south-east of the Baltic, retained possession of that territory, and eventually became masters of all Prussia, and built the cities of Elbing, Marienburg, Dantzic, Konigsberg, &c.

Divisions, however, having subsequently crept into the order, and the kings of Poland, who were then rising into political importance, wishing to take advantage of the knights, Vladislas engaged them in the field, and in a battle fought in 1331 is said to have slain 20,000 of the troops of the order. The knights eventually yielded to his son Kasimir the Great Upper Prussia, and did homage to him for the Lower. At the time of the Reformation, Albert, margrave of Brandenburg, then grand-master of the Teutonic Order, on becoming a Lutheran, renounced the dignity of grand-master for that of Duke of Eastern Prussia, dissolved the commanderies, and drove the knights out of Prussia. Most of them embraced the Reformation, the rest transferred the seat of the order to Margentheim or Mariendal in Franconia, where, after some ineffectual attempts to regain their power, they fell into insignificance. The dukedom of Prussia eventually gave the title of king to the Margrave of Brandenburg. By the peace of Presburg in 1805 the Emperor of Austria, Francis II., was made grand-master. In 1809 the order was abolished by Napoleon, but it has still a titular existence in Austria.

TEVIOTDALE. See ROXBURGHSHIRE.

TEWKESBURY, a municipal borough of England, in the county of and 9 miles north by east from Gloucester, and 114 miles from London by rail, is situated on the eastern bank of the Upper Avon, near its junction with the Severn. The small rivers Carron and Swilgate, tributaries of the Avon, flow through the parish. There are two handsome iron bridges, an ancient stone bridge of several arches over the Avon, and stone bridges over the Carron and Swilgate. The town consists chiefly of three good streets, with several smaller ones branching from them. Tewkesbury Abbey Church is built chiefly of two styles of architecture—Norman, of a very plain plan, and a beautiful variety of Middle Decorated. It was included by the commissioners of Henry VIII. in their list of buildings as unnecessary or superfluous, but was purchased by the town. There is a town-hall, with a hall for the corporation, and an assembly-room in the upper part, and rooms for the borough courts in the lower. The market-house is a handsome building, and there is also a corn exchange. The municipal borough is governed by four aldermen (one of whom is mayor) and twelve councillors. The town was incorporated by Elizabeth in 1574. It returned two members to Parliament from 1609 to 1867, and one from 1867 to 1885, when the parliamentary representation was merged in that of the county. The population of the borough in 1881 was 5100. The name is derived from Theot, a Saxon recluse, who, during the latter period of the Octarchy, founded a hermitage here, and from whom it was called Theotisberg, whence its present appellation. A great battle was fought near it, 14th May, 1471, in which Queen Margaret and her son were taken prisoners.

TEX'AS, the largest of the United States of North America, is bounded on the N. by New Mexico, the Indian Territory, and Arkansas; on the E. by Arkansas and Louisiana; on the S.E. by the Gulf of Mexico; and on the S.W. and W. by Mexico and New Mexico. The Red River separates it in part from the Indian Territory and Arkansas, the Sabine from Louisiana, and the Rio Grande from Mexico. Its shape is very irregular, but its extreme length from S.E. to N.W. is more than 800 miles, and its greatest breadth from E. to W. about 750 miles, including an area of 274,356 square miles. In the south-east along the coast is a level belt of land from 30 to 60 miles in breadth. The soil here is principally a rich alluvium, with scarcely a stone, yet singularly free from stagnant swamps. This is succeeded by an undulating and prairie country, occupying another belt of from 150 to 200 miles in width, which is followed in the west and north-west by the mountainous region and the table-land. The extreme north is invaded by the Great American Desert, which extends about 60 miles within the boundary of the state. The plateau of Texas, including part of New Mexico, extends from 30° to 31° N. lat., and from the Rio Grande east for 300 miles. The north portion, called Llano Estacado, or "Staked Plain," is 2500 feet above the sea. This broad district is destitute of forest trees and shrubs, except along the margins of the streams, and even there never extending 100 yards from the banks. In Eastern Texas wooded lands, called cross timbers, alternate with prairies, and the country has a park-like and delightful aspect. The rivers of the state are generally surrounded with alluvial lands of from 3 to 20 miles in width, which are of great fertility and heavily timbered. Almost all the north part of Eastern Texas is included in the undulating country. The west and north-west is a well-watered and fertile region. A low range of mountains, called the Colorado hills, runs in a north and south direction, east of the Colorado River; indeed, the whole section of the state in the same parallel, between the Colorado and Brazos rivers, is broken with low mountains. Between the Colorado and the Rio Grande, and north of the sources of the Nueces and San Antonio, the country is crossed by outlying ridges of the great Rocky Mountain chain.

Texas abounds in minerals, including gold and silver and an abundance of coal. Iron is found in many parts of the state; there are also salt lakes and salt springs, copper, copperas, alum, lime, agates, chalcedony, jasper, and a white and red sandstone. Deposits of nitre and sulphur, and fireclay, are also among the minerals. There is a pitch lake, 20 miles from Beaumont. An immense bed of gypsum, the largest known in North America, reaching from the Arkansas to the Rio Grande River, traverses the north-west portion of the state. Mineral springs abound.

The coast is lined with a chain of low islands, which form a series of bays, sounds, and lagoons; the most important of them is Galveston, which extends about 35 miles inland from the Gulf of Mexico, in a direction nearly north. The inlets to these are much obstructed by bars. Texas is crossed by several long rivers, which generally rise in the table-lands of the west and north-west, and pursuing a south-east course discharge their waters into the Gulf of Mexico. Commencing with the Rio Grande, the largest river in Texas, 1800 miles long, and which forms its south-west boundary, and proceeding along the coast, we have the Nueces, San Antonio, Guadaloupe, Colorado, Brazos, Trinity, Neches, and Sabine, whose lengths in the order named are about 300, 250, 275, 800, 500, 400, 300, and 350 miles. The Canadian, a branch of the Arkansas, crosses the north of the state. The Red River rises in the north-west, and forms a large part of the north boundary line. All of these are navigable to a greater or less extent, depending on the wetness or dryness of the season, and on local obstructions. There are a number of small rivers or tributaries, navigable to some extent, and besides their value as channels of commerce, they afford in many instances excellent sites for mills. There are no lakes of importance. Sabine Lake, an expansion of the river of that name, near its mouth, 20 miles long, is on the boundary of Texas and Louisiana. There is also a salt lake near the Rio Grande, from which large quantities of salt are annually procured.

Texas enjoys a temperate climate. The heats of summer are much mitigated by the refreshing breezes from the Gulf, which blow with great steadiness during that season. Ice is seldom seen in the south, and during the summer months the thermometer averages about 80°, and in winter from 60° to 75°.

The general character of the soil is one of great fertility. The mesquit grass in West Texas yields a fine soft sward, which is green even in winter, and affords, beyond all comparison, the best natural pasture in the world. The stock range is common to all, and the cattle require no other attention, summer or winter, than herding and the annual branding of the calves. The breeding of sheep is carried on to a considerable extent, the climate being well adapted for the purpose. As the wool is of much more value than the carcase, such sheep are chiefly sought for as will produce the former in the largest quantity and of the best quality. Cotton grows well in almost every part of the state, and that produced near the Gulf is considered equal to the celebrated Sea-island. Indian corn, the other great staple, is also readily raised in almost every part. Rye, oats, buckwheat, and the other small grains also flourish. The level country is well adapted to the production of sugar, though it is not yet extensively cultivated. Tobacco of a quality claimed to be equal to that of Cuba, flourishes with little care, and is doubtless destined to form one of the staples of Texas. Indigo of a superior kind is indigenous to the state. Rice can be cultivated to any extent, and the soil is well adapted for flax and hemp. The grape, mulberry, and the vanilla are indigenous and abundant. The nopal, famous for the production of the cochineal insect, and the tea tree, a good substitute for the Chinese shrub, are native plants. The cacti and agave are abundant west of the Nueces. Cayenne pepper is grown in vast quantities. The fruits, which are no less abundant and various than the other products, include the peach (superior to that grown further north), nectarine, quince, fig, plum, crab-apple, and a great variety of berries. Oranges, lemons, limes, and melons grow well, as do all the garden vegetables. Hickory, walnut, and pecan-nuts are plentiful.

The forest trees of Texas include oak, cedar, pine, palmetto, ash, walnut, hickory, pecan, mulberry, cypress, elm, and sycamore.

Texas abounds in wild animals of different kinds. The buffalo roams in the north-west; and the wild horse or mustang, as well as wild cattle, feed in herds on its undulating prairies. There are also several kinds of deer, pumas, jaguars, ocelots and wild cats, black bears, wolves, foxes, peccaries, racoons, opossums, rabbits, hares, and abundance of squirrels. The prairie-dog, described by some authorities as a species of marmot, burrows in the ground, and their communities extend for many miles. There are many varieties of birds and fish.

Texas has but few manufactures. There is extending railway communication, and the state has great facilities for both internal and foreign commerce. Her most fertile districts are crossed by rivers more or less navigable by steam and smaller boats, while her numerous bays form harbours for transacting her foreign trade. It is true that in some instances her rivers are obstructed by sandbars and rafts, but these admit of removal. The principal article of export is cotton.

According to the census of 1850 Texas had 212,592 inhabitants. The population in 1880 had increased to 1,591,749.

From 1690 Texas formed part of the Spanish viceroyalty of Mexico. When that country threw off the yoke of Spain, and the confederation called the United Mexican States was formed, Texas was annexed to the state of Coahuila. This union was very unpopular with the Texans, and in 1824 the district was raised to the position of a separate state. In 1836 a war of independence broke out with Mexico, and resulted in the complete success of the Texans, the Mexican president, Santa Anna, having been captured and his army completely routed at the battle of San Jacinto. Up to 1845 Texas remained an independent republic, and was acknowledged as such by the United States, England, France, and Belgium; but as the Mexican government still refused to accept the fact, proposals were made to annex the country to the United States, and after a lengthened negotiation it was admitted to the Union in 1846. Disputes arising with Mexico as to the boundary (Mexico claiming to the Nueces, and the United States to the Rio Grande del Norte), war ensued, in which General Taylor gained two battles within the limits of the present state of Texas. The treaty with Mexico, at the close of this war, assigned to Texas the Rio Grande as its south-west boundary. By the Compromise Act of 1850, the boundaries of Texas were somewhat modified, she conceding to New Mexico a portion of her northern territory, in consideration of 10,000,000 dollars to be paid by the United States government.

In the great Civil War of 1861–65, the state joined the cause of the Confederates, declaring its separation from the Union by an act of Secession, dated 11th January, 1861. It was re-admitted in 1870.

The name Texas is of Indian origin, and signifies "plenty." It was given to the country in consequence of its extensive plains and the vast herds of deer, bisons, and antelopes which were formerly found in it.

TEX'EL, the southernmost of the chain of islands stretching along the north-west coast of Holland, at the mouth of the Zuyder Zee, separated from the mainland by the channel of Mars Diep; it is about 14 miles long, with an average breadth of 4 miles, and is covered with rich pastures supporting large numbers of sheep and cattle. It has one market-town (Den Burg). The northern extremity of the island is called Eijerland (land of eggs), on account of the myriads of sea-fowl which visit it. The eggs are collected in great numbers and sent to the Amsterdam market. The population of Texel is 7000.

Off this island, 31st July, 1653, the English fleet, under Monk, defeated the Dutch under Van Tromp, who lost his life in the action. This battle brought the Dutch War to an end.

THACKERAY, WILLIAM MAKEPEACE, a distinguished English novelist, was born at Calcutta on 18th July, 1811. His father was Richard Thackeray, son of W. M. Thackeray of Hadley, near Barnet, in Middlesex. His father and grandfather were Indian civil servants. His mother was left a widow in 1816, and was married a few years afterwards to Major Carmichael Smith, with whom Thackeray lived on terms of friendly intercourse till the major died. "The dear old stepfather is so gentle and good-humoured," he writes to a friend. Thackeray was educated at the Charterhouse School, and spent a year at Trinity College, Cambridge. Thence in 1831 he went to Weimar, spending some portion of his earlier years between that town and Paris. When he came of age in 1832 he inherited a considerable fortune, which he speedily dissipated, partly at the gaming table, and partly in unsuccessful newspaper speculations. Then he contemplated becoming an artist, and studied long at Paris. Fortunately, however, for himself and the world, he discovered in time the real bent of his genius, and betook himself to literature, finding in 1837 regular employment on the staff of *Fraser's Magazine*, in which publication appeared in succession "The History of Samuel Titmarsh and the Great Hoggarty Diamond," the "Yellowplush Papers," "The Luck of Barry Lyndon," and "The Confessions of George Fitz-Boodle." In this same year (1837) he married, and the tragedy of that event Mrs Carlyle has told in characteristic fashion: "Thackeray married Miss Shawe, in part to take her away from a disagreeable mother. She, far too small a thing for a great riotous, energetic man like Thackeray, sank under the anxieties, and went silly after her third confinement." It is but too true that Thackeray, whose tenderness of heart was known to all his intimate friends, had to endure the sorrow of separation from his wife on account of her insanity. Of the three children, Anne, Jane, and Harriet, Anne became Mrs. Richmond Ritchie, the novelist, Jane died as a child, and Harriet became the wife of Leslie Stephen. In 1840 Thackeray published the "Paris Sketch Book," and in 1842 he began to write for *Punch*, started not long before by Douglas Jerrold and others. For this journal he wrote "The Snob Papers," "The Ballads of Policeman X," and numerous other contributions. In 1843 he wrote the "Irish Sketch Book," using the name of Michael Angelo Titmarsh, and a year later travelled in Turkey and Egypt, writing of his experience under the heading "From Cornhill to Grand Cairo." In 1846 "Vanity Fair" was commenced in numbers. It was followed by "Pendennis" in 1850 and "Esmond" in 1852. "The Newcomes" (1854) is in some measure a sequel to "Pendennis," as "The Virginians" (1858) is in some measure a sequel to "Esmond," but Thackeray delights to introduce certain of his characters into nearly all his books. In 1861 he wrote "The English Humorists of the Eighteenth Century," which he delivered as a course of lectures at Willis's Rooms the same year. Lecturing brought him money, which he wanted in order to make provision for his girls, and he prepared a second course on "The Four Georges." These two series he delivered throughout England and the United States. The lectures on the "English Humorists" are very entertaining, although Thackeray is extremely unjust to both Swift and Sterne. The lectures on "The Four Georges" were scathing attacks on those monarchs, and, indeed, might be summed up in the author's well-known lines—

> "George the First you know was vile,
> Viler George the Second;
> Has any mortal ever heard
> Any good of George the Third?
> When George the Fourth from earth descended,
> Heaven be praised the Georges ended."

In 1857 Thackeray became the Liberal candidate for Oxford, losing the contest by 53 votes. In 1859 he undertook the editorship of the new *Cornhill Magazine*, which became a splendid success in his hands, and a source of considerable gain to himself. Meeting a friend soon afterwards, he spoke of purchasing the house of Lord Macaulay, who had just died. The friend remarking on his prosperity, he replied, "To make money one must edit a magazine." He did not buy Macaulay's house, but built a mansion at Palace Green, where he died the day before Christmas Day, 24th December, 1863, and was buried at Kensal Green. For the *Cornhill Magazine* he wrote his unfinished novel "Denis Duval," the last chapter of which appeared in June, 1864, the "Roundabout Papers," a series of humorous essays, and "The Adventures of Philip on his way through the world, showing who robbed him, who helped him, and who passed him by." This clever story, originally published in 1860, was a continuation of "The Shabby Genteel Story," which appeared in *Fraser's Magazine*. Thackeray's other works include "Jeames's Diary," (1841), "The Second Funeral of Napoleon" (1841), "The Chronicle of the Drum" (1841), "Mrs Perkins' Ball" (1847), "Our Street" (1848), "Dr. Birch and his Young Friends" (1849), "Rebecca and Rowena" (1850), "The Kickleburys on the Rhine" (1851). In "Novels by Eminent Hands," he made clever parodies of Lytton, Disraeli, Lever, G. P. R. James, and other writers. James's works scarcely survived Thackeray's satire.

It has often been the custom to regard Thackeray as a cynic of a not too sympathetic nature. The charge is very remote from the truth. No adequate life of him has been published, but there is abundant evidence that he was one of the most loving and noble-hearted of men, tenderly attached to his mother, devoted to his children, and ready at any sacrifice to do a kindness for a friend. "I am very much pained," he writes to Mrs. Brookfield at Charles Buller's death. "Good God! think about the poor mother surviving, and what an anguish that must be! If I were to die, I cannot bear to think of my mother living beyond me, as I dare say she will. But isn't it an awful sudden summons? There go wit, fame, friendship, ambition, high repute! Ah! *aimons-nous bien.* It seems to me that is the only thing we can carry away. When we go let us have some who love us whatever we are."

If he did not touch religious problems, as some have urged, that was not because he was blind to them or looked at them superficially, like Macaulay and Dickens, but because he did not consider that it was within the province of his art. In another letter he writes about "John Mill's noble article in the *Westminster Review*, wherein, as it seems to me, a great soul speaks great truths; it is time to begin speaking truth, I think. Our Lord spoke it and was killed for it, and Stephen and Paul. We shuffle and compromise, and have Gorham controversies, and say, 'Let things go on smoothly.'"

The twenty-six volumes of Thackeray's works display many gifts—no mean poetic power, skill as satirist, humorist, and abundant capacity for writing history or criticism; but it is upon the volumes which contain his five great novels that his fame rests so securely. These works are, it is true, a terrible censure on society. If Dickens throws a halo over the sorrows of the poor, Thackeray sketches with grim realism the vices and follies of the rich. Had he written only "Vanity Fair," "Pendennis," and "The Virginians," we might still love him, and say that nowhere else in fiction was such delicate satire and such masterly portraiture of some phases of life. We might thank him, above all, for painting such a hero as Dobbin, who wins our heart, not by his charms of manner or intellectual supremacy, but by his sterling moral worth, and yet we might feel that something was lacking. In a preface to "Pendennis" he admitted that he did not paint conventional heroes. "Since the author of 'Tom Jones' was buried," he continues, "no writer of fiction among us has been permitted to depict to his utmost power a *man*.

You will not hear what passes in society, in the clubs, colleges, mess-rooms, what is the life and talk of your son." Yes, all this we will hear, and at a certain age we may read it with interest and advantage, but because we want our sons to grow up like Thackeray himself, noble, generous-hearted, and brave, without the mud-bath prepared for Osborne, Pendennis, and the like, we would fain set before them ideals of life in their early years rather than the unpleasant realities to which Thackeray has treated us so abundantly. That is why Thackeray is so much more lovable in "Esmond" and "The Newcomes." "Esmond" is one of the greatest historical novels ever written, free from the anachronisms of Scott's delightful stories, and showing us eighteenth-century life with a masterly attention to detail. On the human side the book is thoroughly healthy. Thackeray, it is true, in a fit of spleen told a friend that the hero, Colonel Esmond, was a "prig;" but he has many manly characteristics. Rachel Castlewood is certainly a good and true-hearted woman, and is, next to Ethel Newcome, Thackeray's noblest female character.

Charlotte Brontë, who gave to Thackeray the enthusiastic hero-worship of her early years, who dedicated "Jane Eyre" to the author of "Vanity Fair," and spoke of him as "the first social regenerator of the age," was vexed by his treatment of women; but Ethel Newcome is a creation worthy of Shakespeare. In spite of her displaying some of the faults and weaknesses of her environment, she is a revelation of true womanliness, as her uncle, Colonel Newcome, is a revelation of true manliness. The worldling will call Colonel Newcome foolish, but what a contrast to his ideas is his unselfishness and sincerity. No passage in literature has such true and touching pathos as that in which the old colonel kisses Ethel's hand in recalling the love tragedy of his own early life. Colonel Newcome never loses his hold on our sympathy: as poor pensioner we reverence his manly dignity as much as in the years of his highest prosperity. And it was no hard-hearted cynic, no mere cold-blooded satirist, who takes us thus to the colonel's death-bed:—"At the usual evening hour the chapel bell began to toll, and Thomas Newcome's hands outside the bed feebly beat time; and just as the last bell struck, a peculiar sweet smile shone over his face, and he lifted up his head a little, and quietly said, 'Adsum,' and fell back. It was the word we used at school when names were called, and lo, he whose heart was as that of a little child had answered to his name, and stood in the presence of the Master."

In the opinion of Anthony Trollope "Esmond" is Thackeray's greatest work, because it gives us with such remarkable skill the language as well as the life of the eighteenth century. The judgment of a large number of readers who have been touched by the tenderness displayed in the later chap 's has pronounced in favour of "The Newcomes." But whilst we could ill afford to lose Beatrix and Lady Castlewood, Colonel Newcome and his son Clive, the campaigner and her daughter Rosey, it may yet be questioned whether Thackeray is not well and rightly known as the author of "Vanity Fair." Certainly "Vanity Fair" is not such pleasant reading as "Esmond" and "The Newcomes," although Beatrix and Mrs. Mack are not the most agreeable of acquaintances; nevertheless it is its author's greatest triumph, his one novel, and one of the few novels in literature which can stand the test of being read and re-read a great many times. "Your business, poet," said a friend once to Goethe, "is to touch a feeling heart!" "Ah, those feeling hearts!" he replied, "any bungler can touch them." And it is not so much in any appeal that it makes to sentiment that "Vanity Fair" is great as in its profound insight, delicate satire, and refined humour. How all the characters in this famous gallery of portraits have fixed themselves in our memories! It is true that Amelia Sedley is very silly, and Becky Sharp is very base, that George Osborne is selfish, and Jos. Sedley cowardly. Yet Thackeray differs from the realistic novelists of a later date in that no man or woman was ever made the worse by coming in contact with his creations, but ofttimes a great deal better. What a scourge to the world of vanity he painted to make his only gentleman therein a grocer's son. What a satire on the heroics of the hack novelists to make him large-footed and uncouth. Yet who does not love Dobbin and revere him for the patient care with which he watches over the girl he loves, sees that her accepted lover is true to her, and after her first husband's death waits fifteen long years before the prize is won. "The vessel is in port. He has got the prize he has been trying for all his life. The bird has come in at last. There it is with its head on his shoulder, billing and cooing clean up to his heart, with soft outstretched fluttering wings. This is what he has asked for every day and hour for eighteen years. This is what he has pined after. Here it is—the summit, the end, the last page of the third volume." This romance of middle age is not, it may be, an idyll that commends itself peculiarly to the young; but who shall say what countless Dobbins it has aided in the battle of life. Becky Sharp, again, is a heroine of very disagreeable characteristics, and we feel that she is disagreeable; we feel that she is everything which a true woman is not, and we see, as few books have made us see, the power for good or evil that one single woman may play in moulding the character and making or marring the lives of men. That power is displayed once again in "Pendennis," where the selfish and not very high-souled hero is saved from shipwreck by his good mother and the loving girl who becomes his wife. It will be seen, we think, from these brief references, how entirely unjustifiable was Ruskin's advice: "Read no word of Thackeray." To know Thackeray's writings is to have at command a fund of wise thought, just insight, and sound criticism of life. Side by side with Henry Fielding, Walter Scott, and Jane Austen he is one of the four pre-eminent British novelists.

Thackeray gave strict injunctions that no life of him should be written, and his wish has been complied with. See however, Anthony Trollope's interesting critical monograph in Macmillan's "Men of Letters Series," Mrs. Brookfield's "Unpublished Letters of Thackeray" in *Scribner's Magazine* for 1887, and the "Memoirs of Ann Gilchrist" (1887); also "Thackeray the Humorist and Man of Letters" (1864), and "Thackerayana" (1875). A volume of sketches, fragments, and drawings by Thackeray, with notes by his daughter, was published in 1875, under the title of "The Orphan of Pimlico." There is one edition of Thackeray's works in thirteen volumes, and several illustrated editions in twenty-six volumes, with a critical introduction by Leslie Stephen. For further criticism see Roscoe's "Essays," Brimley's "Essays," Barnett Smith's "Novelists," Senior's "Essays on Fiction," and Hannay's "Studies on Thackeray."

THA'IS, the celebrated mistress of Alexander the Great, was an Athenian courtesan of the period. She accompanied the king to Asia, and has rendered herself immortal by having induced the conqueror to set fire to Persepolis to avenge the Greek soldiers who had fallen in battle. Dryden has made the episode the subject of his "Alexander's Feast," which Handel set to music. At Alexander's death Thais accompanied Ptolemy to Egypt.

THALAMIFLO'RÆ, in botany, is a large group of the polypetalous dicotyledonous plants, characterized by having the calyx, corolla, and stamens free from the ovary and springing directly from the *thalamus* or receptacle. The divisions of this group are given in the article BOTANY.

THAL'BERG, SIGISMUND, the celebrated pianist, was born at Geneva on the 7th of January, 1812, and educated at Vienna. At the age of thirteen he left Vienna to receive lessons from Pixis at Paris; from thence he

went to London and placed himself under Moscheles. On his return to Vienna he sought the assistance of the celebrated Sechter, the organist to the court. While with this worthy and learned contrapuntist, he became initiated in the rules of composition, and rendered himself familiar with all the varieties of the severe school. Devoting himself entirely to the pianoforte, Thalberg became the great master which he was acknowledged to be all over the civilized world. Either by the natural conformation of his hands, or by the most felicitous practice, he acquired an equality of touch and amazing division of his fingers, which enabled him to dispose a harmony in a manner as extended and effective as the modern orchestra. By means of the elasticity and control which he displayed in his touch, the prodigious power of his wrists, the exquisite brilliancy of his tone, and the rapidity and certainty with which he passed from one distant interval to another, he so separated the different features of his accompaniment, that his performance had truly the effect of four hands, rather than of two. Some of his "three hand" and "four hand" effects he embodied in compositions which add sound musical work to the glitter of their showy construction. His variations on the "Carnaval de Venise," "The last rose of summer," and "Home, sweet home," although now rarely heard, were in their time great favourites, especially with the excellent pianist, Madame Arabella Goddard, who was never weary of playing them to audiences who perpetually demanded them. This class of music is not lofty; but these pieces are the best of their class. Thalberg died in April, 1871.

THALEI'A or **THALI'A,** the muse of comedy; one of the nine muses. In statuary she generally wears a fringed (actor's) mantle, holds a rustic shepherd's crook, and carries a laughing mask in her other hand.

THA'LER, the well-known German coin (Reichsthaler) of the older coinage, now replaced by the mark and its multiples. The old thalers are still largely in circulation, and are taken as three-mark pieces. The mint-par value of the Reichsthaler is 2*s.* 11¼*d.*, 18·5185 grammes, ·900 fine; and it used to be divided into 30 silbergroschen (*neugroschen*).

Other thalers are the *Union-thaler* of Austria, precisely equal to the Reichsthaler, and containing 1½ gulden or florins, now superseded by the monetary laws of 1867 and 1870, though still taken at its value; the thaler of Hamburg, of the same value within a fraction; the *Maria-Theresa thaler* or *Levantine*, with 28·075 grammes of silver, ·833 fine, worth 4*s.* 1½*d.* English, and now not often seen in circulation; the *Lübeck thaler*, worth 3*s.* 4*d.* English; and the *Mecklenburg thaler*, worth 2*s.* 11*d.*, divided into 48 schillings.

The word thaler is another form of the word dollar, which serves to designate some coin or other in almost every civilized tongue.

THA'LES, the father of the Greek philosophy, was born at Miletos, a city of Asia Minor, about 635 B.C. The earliest efforts of speculation were put forth, not in the mother country, but in the Greek colonies; and the Ionian philosophers, with Thalês at their head, took the lead. He supposed water to be the principle of all things, the ultimately real, the groundwork and origin of the universe. Aristotle says ("Metaph." i. 3) that he was probably led to this opinion "from observing that all nourishment is moist, that heat is generated from moisture, and that life is sustained by heat." Take away moisture, and the universe would be dust and ashes; add moisture, and the desert blossoms like the rose. Such crude cosmogonies as those of Thalês and the other early Greek speculators are important, not on their own account, but on account of the incipient philosophical tendency which they attest. They show that the spirit of generalization, which searches for a principle of unity in all things, was beginning to declare itself. They stand opposed to the mythological fancies which had heretofore prevailed. They evince a disposition to find out not merely relative truth, that is, truth as it presents itself to man, but absolute truth, that is, truth as it exists in itself and for all intelligence. This aim, however, is not consciously proposed, still less is it successfully realized. The name of Thalês is usually placed at the head of the list of the seven sages or wise men of Greece. These men were rather practical politicians than philosophers. They lived at a time when the old Greek tyrannies were tending to become republics; and they exerted all their sagacity and influence to bring about the change. In political wisdom and in pithy sayings, Thalês was inferior to none of his compeers. Being asked what was the rarest of sights?—"A tyrant," said he, "well stricken in years;" ominous words, which indicated that the reign of purely arbitrary government was drawing to a close. At this time the Ionian cities were isolated and independent of each other. Thales strongly advised his countrymen to enter into a confederation with the other Ionians, in order that by a union of forces they might defy the invasion with which they were threatened, first by the Lydians, and afterwards by the Persians. This wise advice was rejected, and the consequence was that his country was within a short period subjugated successively by these two powers. This happened about 550 B.C. His astronomical knowledge is said to have been so great that he was able to calculate eclipses of the sun. He died about 545 B.C., at the age of ninety.

THALIC'TRUM is a genus of plants belonging to the order RANUNCULACEÆ, distinguished by the absence of the petals. *Thalictrum aquilegifolium* (the feather columbine) is a native of Europe, in woody districts of Germany, France, and Italy. It is a bushy herb, with glaucous leaves tinged with purple, and large panicles of flowers, conspicuous by their sulphur-coloured stamens. It is often grown in shrubberies. *Thalictrum flavum* (common meadow-rue) is a native of all districts in Europe. In Britain it occupies wet meadows, the banks of rivers, and ditches. It is a tall, erect herb, with glaucous bipinnate leaves and compact panicles of erect flowers, with yellow stamens. *Thalictrum minus* (lesser meadow-rue) is a native throughout Europe. In Britain it is found in chalky pastures, and on the sea-coast where shell-sand abounds. It is distinguished by its zigzag stem and loose panicles of drooping purplish flowers. *Thalictrum alpinum* is found on the higher parts of mountains in Britain. It has a simple nearly leafless stem and drooping white flowers. Two or three other species are British.

THAL'LIUM, a rare element, first discovered by Crookes in 1861, in the deposit from the chambers of a sulphuric acid manufactory, situated in the Hartz Mountain. The deposits contain selenium, and on the distillation of the selenium a considerable residue was left in the retort, which was supposed to be tellurium, until spectrum analysis revealed the presence of a new metal, the spectrum of which consists of a single line of a brilliant green colour, hence the name, from Gr. *thallos*, a green bud. This element has since been found to be widely distributed, especially in iron and copper pyrites, but it is only found in very minute quantity. It is often present in zinc ores, also in those of cadmium, bismuth, mercury, and antimony, and in the metals made from these ores. It is also found in native sulphur, selenium, and tellurium, in lepidolite and mica. The best source of thallium is the flue dust deposited in the pipes leading from the burners to the chambers, in works where thalliferous pyrites is burned for the manufacture of oil of vitriol. The flue dust is boiled in water, and to the solution strong hydrochloric acid in excess is added. An impure chloride of thallium crystallizes out. This crude salt is heated with oil of vitriol until all the

hydrochloric acid is driven off, and the acid sulphate of thallium remains. This is now dissolved in water, and sulphuretted hydrogen passed through the solution; the contaminating metals which separate as sulphides are filtered off, and the solution boiled; it is then made alkaline by the addition of ammonia, and again boiled; oxide of iron and alumina precipitate and are removed by filtration. The solution is then evaporated, and on cooling sulphate of thallium crystallizes out in large prismatic crystals. The pure thallium is obtained from the solution of this salt by precipitating it with zinc. It then presents the appearance of a metallic sponge, which can be fused under a stream of coal gas or under cyanide of potassium.

Thallium is a white metal of considerable lustre and susceptible of a high polish. It quickly tarnishes in air, and becomes covered with a coating of oxide. The specific gravity is 11·85, the symbol Tl, and the atomic weight 204. It is the softest known metal, is easily scratched by the finger nail, and it marks a sheet of paper like plumbago. Thallium is very malleable and is easily hammered into foil, but is with difficulty drawn into wire. It is a very crystalline metal, can be obtained by careful melting and cooling in octahedrons, and melts at 293° C. (559° Fahr.) It is diamagnetic, is a fairly good conductor of electricity, and is most remarkable for the intense green colour imparted by its compounds to flame. The colour is absolutely monochromatic, and the spectrum is the simplest of all the metals, appearing as one brilliant and sharp green line, and the reaction is so delicate that the five-millionth of a grain can be easily detected. Thallium is readily attacked and dissolved by nitric acid, but not by hydrochloric acid, and only slightly by sulphuric acid. Some of the salts are sensitive to light, especially the chloride, and all are highly poisonous; the symptoms are similar to those of lead poisoning. Thallium forms two oxides—the protoxide or thallous oxide (Tl_2O), and the sesquioxide or thallic oxide (Tl_2O_3). The tarnish on the metal when exposed to the air is thallous oxide. It fuses like litharge. It is soluble in boiling water, and on cooling the solution it crystallizes out in yellow needles as the hydrated oxide, or thallious hydrate (Tl_2OH_2O), and these on heating in a water bath are reduced to a reddish-black mass of thallious oxide. It is a powerful base, forming a strongly alkaline solution; it acts as a dye on the hair and nails, staining them a deep permanent brown. In its reaction with metallic salts it resembles potash.

Thallic oxide is a dark brown powder, which is not fusible, and is insoluble in water and alkalies, but soluble in acids, from which the hydrated sesquioxide or thallic hydrate ($Tl_2O_3H_2O$) is precipitated by an alkali; it is a brown powder, easily reduced to thallous oxide.

There are four chlorides of thallium—the protochloride or thallous chloride ($TlCl$), the sesquichloride (Tl_2Cl_3), the dichloride (Tl_2Cl_4), and the trichloride or thallic chloride ($TlCl_3$). The protochloride is formed when thallium is burnt in chlorine gas. It forms a white crystalline mass which is easily fused. The sesquichloride crystallizes in yellow hexagonal plates. The dichloride is a pale yellow deliquescent substance. The trichloride crystallizes in colourless prisms and is very fusible. Similar compounds are formed with bromine—protobromide ($TlBr$), sesquibromide (Tl_2Br_3), dibromide (Tl_2Br_4), and tribromide ($TlBr_3$). Thallous iodide (TlI) is a beautiful yellow insoluble powder. Thallic iodide (TlI_3) crystallizes in brown rhombic prisms. The principal salts of thallium are those of the protoxide or thallous salts. Thallous nitrate crystallizes in needles, having the formula $TlNO_3$. The thallic salts, or salts of the peroxide, may be also represented by thallic nitrate, which has the formula $Tl(NO_3)_3$.

Thallium may be always recognized by the green line of the spectrum in presence of all other metals. In solution a very delicate test for its presence is iodide of potassium, which gives a yellow precipitate of thallous iodide, even in very dilute solutions of thallous salts.

Thallium would probably be much employed in pyrotechny if it were less expensive, on account of the brilliancy of the green flame. When fused with sand and litharge it forms a very brilliant glass, which has a specific gravity of 4·233, and is the most refractive glass known; by increasing the proportion of thallium the density has been increased to 5·025. The reactions of thallium, corresponding as they do to potassium in some respects, and to lead in others, make it difficult to class this element, and induced Dumas to call it the ornithorhynchus among the metals.

THALLOPHYTES. See CRYPTOGAMIA.

THALLUS or **THALLOME** is the term applied to the vegetative structure of the Thallophytes, the lowest group of the CRYPTOGAMIA or flowerless plants. The thallus is composed of simple cellular tissue, exhibiting no distinction of stem and leaves, and without true roots.

THAMES, the most important river in Great Britain, rises in the central part of England, and flows eastward into the German Ocean. The spring which is often regarded as the source of the Thames is about 3 miles southwest from Cirencester, near a bridge over the Thames and Severn Canal which is called Thames-head Bridge; but that which is in reality its true head is about 3 or 4 miles south from Cheltenham. Two streams rise, one from fourteen springs, at what is popularly called the Seven Wells, the other from four springs near Ullen Farm, and the most western of the latter is the remotest source of the river. Both streams rise on the south-east slope of the Cotswolds, and form by their junction, about a mile from their respective heads, the river Churn, which flows on the east side of Cirencester, and thence south-east to Cricklade. At the latter town, 19 or 20 miles S.E. from its source, the Churn joins the Isis, or commonly reputed Thames, but the length of which above the junction is only about 10 or 11 miles.

From Cricklade the river flows 9 or 10 miles E.N.E. to Lechlade, receiving on the way the Ray (11 miles long) and the Cole (14 miles long), both on the south bank. Just above Lechlade it receives on the north bank the Colne (23 miles long) from the Cotswold Hills east of Cheltenham, and shortly afterwards the Lech or Leach (19 miles long), which also rises in the Cotswolds. From Lechlade the river flows 14 miles east to its junction with the Windrush (34 miles long), which rises in the Cotswolds, and joins the Thames on the north bank. Below this junction the river makes a bend to the north and north-east, receiving on the north bank the Evenlode (31 miles long). This stream rises in the Cotswolds, and the Glyme, which flows through Woodstock and Blenheim Park, is one of its tributaries. The Thames then turns south and flows to Oxford, where it receives the Cherwell (44 miles long), which rises in the Arbury Hills near Daventry, and also joins it on the north bank.

From the junction of the Cherwell the Thames flows 16 miles S.S.E. to its union with the Thame at Dorchester, making, however, a considerable bend west to Abingdon, where it receives the Ock (18 miles long), which rises at the foot of the chalk hills of Berkshire, between Compton Beauchamp and Ashbury, and joins the Thames on the south-west bank. The Thame rises near Stewkley in Buckinghamshire, and flows 39 miles south-west by the town of Thame into the Thames, which it joins on the north-east bank. From Dorchester the course of the river is south-east 22 miles in a winding channel by Wallingford to the junction of the Kennet (53 miles long) near Reading. The Kennet rises near Broad Hinton, a village north of Marlborough Downs, and joins the Thames on its south bank.

After leaving Reading the river flows east, though in a very winding channel, making first a considerable circuit to the north, by Henley, Great Marlow, and Maidenhead, to Windsor; and then another to the south by Staines,

Chertsey, Kingston, and Richmond to Brentford, whence it proceeds by Hammersmith, Putney, and Chelsea to the metropolis. In this part of its course it receives the Loddon (24 miles long), which rises in the chalk downs of North Hants, near Basingstoke; the Coln (38 miles long), which rises, under the name of the Ver, in the chalk downs of Hertfordshire, and passes St. Albans, Watford, Rickmansworth, Uxbridge, and Colnbrook; the Wey (36 miles long), which rises near Alton in Hampshire, passes Farnham, Godalming, and Guildford, and joins the Thames at Weybridge; the Mole (41 miles long), which rises in St. Leonard's Forest, in Sussex, passes through Leatherhead, and effects a junction at East Moulsey; the Cran and the Brent, two small streams, each about 18 miles long, which rise on the borders of Middlesex and Herts, and join the Thames, the first at Isleworth and the second at Brentford; and the Wandle, a stream only 9 miles long, which joins it at Wandsworth. Of these the Coln, the Cran, and the Brent fall into the Thames on the left or north bank, and the others on the right bank.

Below London, up to which sea-borne vessels ascend, the river flows east, but with various bends or "reaches," 48 miles to the Nore, which is generally considered as the place where it terminates. Between Deptford and Greenwich, about 4 miles below London Bridge, it receives, on the south bank, the Ravensbourne (10 miles long), from Keston, near Bromley in Kent; about 3 miles further down, on the north bank, the Lea (50 miles long), which rises in Bedfordshire, and passes Luton, Hertford, Ware, and Waltham Abbey; 4 or 5 miles lower, the Roding (38 miles long), from near Dunmow, also on the north bank; and 6 miles further down, on the south bank, the Darent (20 miles long), which passes Dartford and receives the Cray. The only remaining feeder of the Thames which requires notice here is the Medway, above 60 miles long, which rises in Sussex, and flows by Tunbridge, Maidstone, Rochester, and Chatham. The principal arm of the Medway joins the Thames at Sheerness just above the Nore, but the smaller arm, called the Swale, which cuts off the Isle of Sheppey from the mainland of Kent, opens into the estuary of the Thames just above Whitstable.

The whole course of the Thames, from its source to its mouth, is about 212 miles, made up as follows:—

	Miles.
Length of the Churn, ...	20
From the junction of the Churn and Isis at Cricklade to Lechlade, ...	9
To the junction of the Windrush, . . .	14
To the junction of the Cherwell, ...	13
To the junction of the Thame, ...	16
To the junction of the Kennet, ...	22
To London Bridge, ...	70
To the mouth, ...	48
	212

The Thames, in the first part of its course, belongs wholly to Gloucestershire, but below Cricklade it is almost entirely a border river, dividing Gloucestershire from Wiltshire, Oxfordshire and Buckinghamshire from Berkshire, Middlesex from Surrey, and Essex from Kent. The navigation of the Thames commences at Lechlade, where it is about 258 feet above low-water mark at London Bridge. The Thames and Severn Canal, which follows the valley of the Churn and the Thames from near Cirencester, opens into the river at Lechlade, thus connecting it with the Severn and the western coast of the island. At Oxford the Oxford Canal joins it, and opens a communication with the great canal system of the central counties. At Abingdon it is joined by the Wilts and Berks Canal, by which—as well as by the Kennet and Avon Canal, which joins the Kennet at Newbury (where the navigation of that river commences, 20 miles above its junction with the Thames)—communication is effected with the Somersetshire Avon, and by it with the Severn. The Thame is navigable from the town of Thame, about 17 miles above its connection with the Thames; and the Wey from Godalming, also about 17 miles from its junction. The latter is connected with the Wey and Arun Canal and the Basingstoke Canal, the former of which opens a communication with the river Arun and the Sussex coast. The Grand Junction Canal, which unites with the Oxford Canal at Braunston, in Northamptonshire, opens into the Thames by the mouth of the Brent, the lower part of which is incorporated with the canal. Below London Bridge the Lea, which is navigable, chiefly by artificial cuts, for 25 miles, opens into the Thames; and just above the Lea the Regent's Canal, which encircles the north and east sides of the metropolis, and communicates with the Paddington Canal, and so with the Grand Junction, also opens into the river. The Medway is navigable below Rochester Bridge for sea-borne vessels, and from Penshurst, above 42 miles from its mouth, for river craft.

The navigation of the Thames, in its upper part, is kept up by means of locks and weirs. The lowest is at Teddington (which is the limit of the tide), about 18 or 19 miles above London Bridge. High-water mark at this place is about $1\frac{1}{2}$ foot higher than at London Bridge, and the time of high water about two hours later. The low-water surface at Teddington is about $16\frac{3}{4}$ feet higher than at London Bridge, so that between the two points there is a fall of about $10\frac{3}{4}$ inches in a mile on an average. At London Bridge the height above the sea-level is 4 feet 3 inches, and the fall from that point to the Nore does not exceed 1 inch per mile. At ebb tide there is a depth of from 12 to 13 feet water nearly or quite up to London Bridge, and the rise of the tide is about 17 feet, or at the extreme springs about 22 feet.

No river in the world equals the Thames in its commercial importance. For some miles below London Bridge it is crowded with vessels, chiefly coasters, steamers, and colliers, which moor alongside the quays or in tiers in the stream; others are moored lower down, though not in such numbers; and for larger vessels there are several magnificent docks on the banks of the river. There are naval dockyards at Woolwich, Sheerness, and Chatham, and very important fortifications at the two latter places. At London Bridge the width of the Thames is 290 yards; at Woolwich, 490 yards; at Gravesend, 800 yards; at Coal-house Point, 3 miles below, 1290 yards; and at the Nore, 6 miles. Eight miles further down it is 18 miles across from Whitstable to Foulness Point. The basin of the Thames has an area of 6160 square miles, or nearly an eighth of the whole of England; but as it belongs entirely to the upper part of the secondary and to the tertiary formation, it is destitute of coal, and hence possesses no manufactures of importance, except those of the metropolis itself. It comprehends, however, some of the richest agricultural districts of the kingdom.

Though not a rapid, the Thames is by no means a sluggish river; it rolls forward with an equable and steady current, and was formerly remarkable for the purity of its waters. It has been admirably described by Denham in his "Cooper's Hill":—

> "Though deep, yet clear; though gentle, yet not dull;
> Strong without rage; without o'erflowing, full."

The rapidity of the current at London has been increased by the embankments on both sides of the river, and the channel consequently thoroughly scoured and deepened.

According to common opinion the Thames obtained its name (said to be Thameisis, shortened to Thames) from the junction of the Thame with the Isis, or with the river coming from Gloucestershire. Probably this opinion, however, notwithstanding its apparent accuracy, has no good foundation. At all events it appears to be abundantly

certain that the river which passes Lechlade, formed by the junction of the streams previously mentioned, has from a very remote period been called the Thames; and that the name Isis, given to it by the literati of Oxford, is not mentioned in ancient charters or by ancient historians, and is wholly unknown to the common people in the country through which it flows.

THAMES TUNNEL. There had been two or three schemes for forming a tunnel under the Thames prior to the one brought forward in 1823 by Mr. (afterwards Sir) Mark Isambard Brunel; one proposing to connect Gravesend with Tilbury; another to commence at Rotherhithe, a little below the site of the present tunnel; and works were actually begun at both these places, but soon abandoned. Brunel proposed to effect his object by means of a framework or shield, which should support the face of the excavation, and allow the earth to be removed on many points simultaneously; the frames or divisions of the shield being then moved slowly forward, and closely followed by a solid mass of brickwork, inclosing two arched passages, 16 feet 4 inches in height from the invert of the arch, and 13 feet 9 inches span at the springing of the arch. It was a work of immense labour, the cost being about £1000 per foot, or £800,000 for the entire work. The horizontal excavation for the body of the tunnel was commenced at the depth of 63 feet, with a declivity of 2 feet 3 inches every 100 feet. The breadth of the present tunnel is 38 feet and the height 22 feet 6 inches, thus presenting a sectional area of 85 feet. The basis of the excavation in the deepest part of the river is 76 feet below high-water mark. On two different occasions the river broke in upon the workmen, and suspended their operations for a considerable time; but the injury was repaired by filling bags with clay and throwing them into the Thames immediately over the chasm made in the bed of the river.

Ultimately all difficulties were overcome, and the tunnel was opened to the public in 1842, seventeen years after the first excavations had been made. It did not, however, answer as a commercial undertaking, but was rather looked upon as one of the sights of London, and it was ultimately purchased by the East London Railway Company for £173,000. The company commenced running their trains through it in 1869.

THAM'URIS or **THAM'YRIS** is often referred to in the classics as an example of presumption. He was a bard of Thrace, and dared to compete with the Muses in art. He fell, and was punished with blindness and the loss of his voice; his lyre, too, was broken, so that he could neither sing, play, recite, nor compose in writing.

THAM'MUZ, a Syrian god, identified with Adonis, whose mention by Milton in his catalogue of the infernal spirits in "Paradise Lost," Book I., calls attention to an otherwise almost forgotten deity. The Tammuz of Ezekiel (viii. 14) is believed to be another form of the word. See ADONIS.

THANE. See THEGN.

THAN'ET, ISLE OF, the north-east part of the county of Kent, in England, having north the estuary of the Thames, east the North Sea, and separated on the south and west from the mainland by branches of the river Stour. This channel was navigable in the time of Cæsar, and even in the fifteenth century was 3 furlongs to a mile broad at high water; but at present the former channel is filled up and has developed into rich marshy land, traversed by small streams. The length of the island is 10 miles and the breadth 5 miles. Its surface is level, composed of chalk, and the soil is fertile. On its coast are the towns of Ramsgate, Broadstairs, Westgate, and Margate. The sea has been long encroaching upon the land. The area is 26,500 acres.

THAN'ET SANDS, a series of light coloured quartzose sands, with occasional clayey beds, forming the base of the EOCENE strata in England, and so called by Professor Prestwich from their typical development in the Isle of Thanet, Kent. Here they attain their maximum thickness of about 90 feet, and are found to become gradually thinner westwards, finally disappearing beyond Epsom in Surrey; and there are apparently no representatives of them beneath the Eocenes in Hampshire. They rest upon the eroded surface of the chalk, which is covered by a layer of flints left behind after the solution and removal of the surrounding rock, and the "break" in the geological history thus indicated is proved by fossils to be one of enormous magnitude. It is a good example of UNCONFORMABILITY, and marks the boundary between the Mesozoic and Cainozoic Epochs. [See GEOLOGY.] The Thanet sands are most fossiliferous in East Kent, where they may be studied in the cliffs of Pegwell and Herne Bays. The remains are almost entirely marine, and include bones of turtles, teeth of sharks (Lamna), and other rarer traces of vertebrate animals, in addition to numerous Mollusca, a few Crustacea, and some Foraminifera. Fragments of silicified wood and stems of ferns (*Osmunda dowkeri*) are also occasionally met with. The most common shells are *Thracia oblata*. *Cyprina morrisii*, and species of Corbula and Ostrea; but there are also a few univalves of the genera Fusus, Natica, Aporrhais, and others, and at least one species of Nautilus. In France the *Sables de Bracheux* are the representatives of these beds, and the Landenien formation of Belgium is likewise considered to be of equivalent age. (See Whitaker's "Geology of the London Basin," published by the Geological Survey, and a paper by Mr. Starkie Gardner in the *Journal of the Geological Society*, 1883; also a paper by Mr. G. F. Harris, read before the Geologists' Association of London, 4th March, 1887.)

THA'SOS, now *Thaso* or *Tasso*, a Turkish island situated off the coast of Macedonia, at a short distance from the mouth of the river Nestus or Karasou, and a little to the south-east of the Gulf of Kavallo. The small town of Volgaro is nearly in the centre of the island. It was enriched in very early times by the possession of gold mines. Thasos is about 40 Italian miles in circumference. Its greatest length is from north to south. In the northern and highest part of the island three peaks extend in a north-west and south-east direction. The inhabitants, amounting to 5000 or 6000, are all Greeks, and live in about twelve villages. The chief produce is oil, maize, honey, and timber; the last forms the chief article of export. The plane trees in particular are of great size. Herds of cattle and flocks of sheep are kept; asses and mules are more used than horses on account of the steepness of the roads. The inhabitants are hospitable, industrious, and simple in their manners.

THAU'MATROPE. Among the many illusions of sight [see article ILLUSIONS], the thaumatrope holds a deservedly high place. It was invented by the ingenious Dr. Paris in the first part of the present century, and depends for its success upon the scientific principle of the persistence of visual impressions on the retina.

In its simplest form the thaumatrope may be produced on a piece of card, to which a thread is fastened at each end, so that the card is easily rotated on the axis of the threads by twirling these latter. If now some letters or parts of letters out of an inscription be traced on one side of the card, and the remainder of the sentence on the other, in appropriate places, then on twirling the card the whole will stand out clear and defined. Or a cage on one side and a bird on the other will show as a bird in a cage. So a jockey may be made to mount a horse and a number of amusing surprises may be devised.

The full development of this principle is, however, seen in the ZOETROPE, where the same optical principle is made use of to create images which are apparently in active motion.

THE'ATINES, a Roman Catholic monastic order, so called from one of its founders (Giovanni Pietro da Caraffa), being the bishop of Theate. Cajetano di Thiene and the bishop, with one or two other friends, resigned all their preferments in order to found an order of absolute poverty, and obtained the incorporating brief from Clement VII. in 1524. The peculiarity by which the new order hoped to escape the snares into which the great orders of mendicant friars had fallen was, that while holding the vow of poverty and living wholly upon charity, they were at the same time forbidden to beg. Caraffa was the first superior, and Thiene the second: Caraffa becoming afterwards Pope, with the style of Paul IV. (1555). At this time the Theatines had much influence. They are now limited in number, and are chiefly found in Sicily and lower Italy.

THEATRE (from Lat. *theatrum*, which is from Gr. *theatron*, a place for seeing), a word adopted in modern languages to signify a building appropriated to dramatic representations. The oldest edifices of this class are those of the Greeks and Romans, for it was with them that the European drama originated; and in point of magnitude their theatres surpassed the most spacious of their temples. The great extent of many, and the prodigious solidity of their construction, are attested by the numerous remains which have been explored not only in Greece and Italy, but also in Asia Minor. In their beginning theatres were temporary enough in their construction. So slight was the wooden stage upon which the first masterpiece of Aischulos (Æschylus) was produced, that it actually broke down beneath the weight of the actors. This accident led to the careful building of the beautiful theatre at Athens (excavated by Stark in 1862), which formed the model for all the others in Greece, and hence, later on, in Italy also.

But the very magnificence and sumptuousness of some of the ancient theatres also prove how destitute of anything approaching to scenic illusion and stage effect the performances must have been. It is evident from what Pliny says of the theatre of Scaurus at Rome, that the *scena* was a mere architectural façade, unmeaning in itself, though lavishly embellished with marble columns and statues. Moreover, it was always a permanent architectural erection, incapable of change, and instead of having reference to the particular performance, must frequently have been at variance with it. Therefore, besides the permanent scena, the ancients employed, at least occasionally, movable painted scenes, capable of being let down before it. Two "versuræ" at the sides or ends of the stage served as "wings;" they were upright triangular frames made to revolve upon a central pivot, so that any of the three sides could be turned towards the audience. The depth of the ancient stage was, in proportion, considerably less than that of modern theatres. In many plays the scena, a sort of palace front, served well. The central door was called the royal door, and was reserved for the principal person of the play, or the chief in rank: a convenient distinction whereby to mark at once the dignity of the chief character to the large audience. (The great Attic theatre held 50,000.) Personages arriving from a distance appeared in the orchestra from the side, and mounted to the principal stage; and the reverse ceremony was observed at the departure of a messenger to a distant land, or the farewell of a guest or traveller.

There were no "footlights" on the ancient stage, and consequently the faces of the performers were not lighted from beneath. Yet even this advantage was nullified by the use of masks, some of them so extravagant as to bear scarcely any resemblance to the human face, whilst in all a fixed expression of countenance was substituted for what should properly be only a transitory one. This was, however, of less consequence, because, owing to the vast extent of the theatres, the faces of the actors could otherwise hardly have been distinctly seen, or even seen at all, by the great majority of the spectators. The ancients had recourse to what seems a strange expedient for transmitting the speaker's voice to the furthest part of the theatre, namely, that of placing in certain cavities beneath the seats hollow metal or earthen vases, which augmented the sound. The manner in which this resonant effect operated is now unintelligible, though nothing can be clearer than the description of the fact by the architect Vitruvius. No experiments have as yet succeeded in reproducing so valuable an assistance, though many have been tried.

On considering the auditorium, and the accommodation provided for the spectators, although there the arrangement of an ancient theatre was in some respects preferable to that of modern ones, it was not free from many inconveniences. The most obvious one is, that there was no roof, and no shelter from the weather, except that the audience was protected from the heat by an awning (*velarium*) drawn over the top of the building. Beautiful too as is the arrangement of the seats in concentric rows (*i.e.* rising in regular succession, one behind and above the other, like the steps of stairs), it is attended with some disadvantage, for instead of being placed, as in the pit of a modern theatre, parallel to and immediately facing the stage, a considerable portion of the audience must have sat sideways to it, and those at the ends of the upper benches could hardly have had any view of the scena at all, at least not in the Greek theatre. See Plate V. illustrating the plan of a Greek theatre in GREEK ARCHITECTURE.

The Greek and Roman theatres closely resembled each other; the general arrangement and the essential parts being the same in both—the *Koilon*, *Orchêstra*, and *Skênê* in the one answering to the *Cavea*, *Orchestra*, and *Scena* in the other. The cavea was the general term for the whole of the space appropriated to the seats of the spectators, which were all concentric with the orchestra, and which were intersected by ascents or flights of steps dividing the seats into compartments.

Between the Grecian and Roman orchestra there was a very wide difference as regards the purpose to which that space was appropriated. In the Roman theatre it was a continuation of the rest of the auditory, being occupied with seats and spectators, with no other difference than that the spectators were senators and other persons of dignity, and that benches or chairs must have been ranged parallel to the stage. The Greek orchestra, on the contrary, was, as its name imports, restricted to the dancers, musicians, and singers, whose performances constituted an important part of the entertainment.

Another point of difference between the Grecian and Roman theatre is, that in the former the stage was considerably elevated above the orchestra, 8 feet or upwards; consequently there was a wall of that height at the back of the orchestra, to which was given the name of Huposkênion, or Lower Scena, and which formed a sort of architectural basement to the stage, and was adorned with niches and statues. A double flight of steps led up the face of the Lower Scena to the stage proper.

The *thumelê* or altar of Dionusos (Bacchus) stood in the middle of the Greek orchestra. The chorus, numbering fifteen, often grouped itself at times, when it was not itself engaged in singing or in dialogue, by fives, five on the altar steps, five on each side of the central steps of the Huposkênion, along the marble bench on the face of the latter for this purpose. It must be remembered that the Greek drama arose out of festivals in honour of Dionusos, at which narratives of his career were dramatically recited, just as our own drama arose out of the sacred mysteries and miracle plays of the priests in our churches. Consequently a play was a sacrifice, with sacred dance and song, in the Greek eyes. The altar smoked with incense, and a direct address to Dionusos was always introduced, usually as part of the play. The altar was made to do

duty in the action, serving as a tomb, or a place whence the leader of the chorus might hold dialogue with the actors on the stage, or for other such uses. In 1885 a London circus was engaged by the architect and classical designer, E. W. Godwin, and was fitted up exactly as a Greek theatre. An English drama on the strict Greek model told part of the tale of Troy; and nothing was more remarkable than the religious character of the whole performance, from the silent entry of the white-robed priestesses at the beginning, coming to feed the altar with incense, to the disappearance of the chorus of Greek maidens at the close, ascending from the orchestra to the stage, and slowly passing away between the falling curtain which had already hidden the actors. The performance was repeated again and again, as long as the building could be retained; and no doubt had not death unhappily overtaken the accomplished conductor of this remarkable revival some fine permanent result might have been secured.

The form of the orchestra determined that of the exterior of the building. While the Roman theatres did not exceed a semicircle, those of Greece had a greater curve. In the Greek theatres, however, the orchestra was not always extended beyond a semicircle, by the curve being continued, but sometimes by straight lines at right angles to the chord. Grecian theatres were almost invariably built on the sloping side of a hill, so that it was merely necessary to shape out the *Koilon* (hollow), and erect the seats, which were often cut in the solid rock; consequently there was no other architectural exterior than that formed by the Paraskênê and colonnade behind the stage. The Roman theatres, on the contrary, were erected on level ground, and therefore the curved part of the exterior was confined to a semicircle, a form which unites better with the rectangular one and its straight lines. For a long time the Romans, in their eagerness to check luxury, forbade any but temporary wooden theatres. Pompey the Great built the first stone theatre, B.C. 55. But neither with Greeks nor with Romans were dramatic performances of daily occurrence. They were limited to great festivals.

The beautiful ruined Dionysos theatre at Athens was by no means so spacious as many others, its diameter being only 250 feet, and that of the orchestra 72 feet, which are very moderate dimensions in comparison with those of some of the provincial theatres. The diameter of the theatre at Milêtos was 474 feet, and that of the orchestra 224 feet. The diameter of the theatre of Marcellus at Rome was 517 feet, and that of the orchestra 172 feet; and it held 40,000. The fine theatre at Orange in France had a diameter of 340 feet, and the proscenium still stands almost intact. From some remains which have been discovered in Cornwall (Piran Round) and other places, it would appear that large open-air theatres, somewhat in the shape of those of Greece, existed in England at a very early period.

Fortunately the ancient theatre was not taken as a model for modern structures of the kind. The revival of theatrical representations took place before anything was known relative to that branch of architectural archæology, and under very different circumstances. Dramatic entertainments were, in the middle ages, either partly religious and performed within churches, convents, and colleges, or were acted for the amusement of princes and nobles on occasions of state and festivity, in halls merely temporarily fitted up for that purpose; consequently spacious and permanent structures, such as our present public theatres, were not required until long afterwards, when the drama had become a distinct profession. In the meanwhile a taste for scenic display had developed itself, which required a very different arrangement of the stage and its apparatus from that of the ancients. Imperfect as they were, the dramatic pageants and recitations performed before Leo X. were exhibited with great magnificence, and some of the greatest artists were employed upon the decorations. It is from this period that we date the complete use of movable scenery, which was an invention shown by Peruzzi in 1508, before his Holiness. Even in the preceding century dramatic exhibitions had been produced at Florence in a style of unusual splendour. Public theatres on the present system were not built till the early part of the seventeenth century, just before which time an attempt had been made to restore the form of the ancient theatre and stage, with the permanent architectural scena and its entrances, by Palladio, whose celebrated Teatro Olimpico at Vicenza was completed by Scamozzi after its architect's death. In the article SHAKESPEARE will be found an account of the earliest English theatres, which arose from a modification of the waggon-stage in the inn-yard, the first scene of our dramatic efforts.

In regard to the form of the interior, a decided improvement has taken place of late years; and the horse-shoe plan, or one approaching to it, first introduced by Fontana at Rome, in 1675, and perfected in La Scala at Milan in 1774, may now be considered the one established as being the most pleasing and commodious. But there is considerable difference of opinion as to its being the best form in regard to hearing. In fact, the science of acoustics is not yet brought to exactness as regards practical purposes in building. Perhaps it is in the matter of lighting and ventilation that we must look for the greatest improvement to be made in modern theatres. Many are still very badly arranged in this respect, generally glaringly bright and insufferably hot. The use of the electric light in most modern theatres accomplishes a great improvement in both respects. It is soft when fully turned on, and remains quite cool; while the moment the play commences it is easily reduced all over the theatre except upon the stage, relieving the strain on the eyes while enhancing the brilliancy of the stage. This device is also adopted in gas-lighted theatres.

While in their internal embellishment and fitting up theatres afford great scope to the architect, they also afford opportunity for accomplishing much in regard to characteristic external design. After all, it is upon the stage itself that the multifarious contrivances and complex mechanism, the elaborate scenery and pictorial effects, manifest the extraordinary perfection to which the moderns have carried the scenic art. It does not enter into our purpose, however, to speak of stage mechanism, which is a technical subject and study by itself, and not very interesting to the general reader. The article DRAMA may be referred to.

According to the latest returns, there are about 1600 theatres in Europe—of which Italy (including Venetia) has 346, France 337, Germany 191, Spain 168, Great Britain 150, Austria 150, Russia and Poland 44, Belgium 34, Holland 23, Switzerland 20, Sweden and Norway 18, Portugal 16, Denmark 15, Turkey 4, Greece 4, Roumania 3, and Servia 1.

THEATRE, in law. Before the reign of Elizabeth theatrical representations appear to have been subject to no legal restraint beyond the liability of those who conducted them to the vagrant laws. But it is probable that the practice of granting licenses from the crown prevailed as early as the reign of Henry VIII. The earliest theatrical license from the crown now extant is that granted by Queen Elizabeth, in 1574, to James Burbage and four other persons, "servants to the Earl of Leicester." These licenses from the crown were originally nothing more than authorities to itinerate, which exempted strolling players from being molested by proceedings taken under the laws or proclamations against vagrants, and also superseded the necessity of licenses from local magistrates.

Although theatrical representations became much more general in the reigns of James I. and Charles I., no laws were enacted for their regulation, with the exception of the

statute 1 Car. I. c. 1, which prohibited the performance of "interludes and common plays" upon the Lord's Day. An ordinance of the Long Parliament, in 1648, was directed to the suppression of all stage-plays and interludes, but though occasionally enforced with much rigour, it failed to abolish them. The 12 Anne, stat. 2, c. 23, in general terms classed players of interludes as rogues and vagabonds; and the 10 Geo. II. c. 28, s. 1, expounded the former statute, by enacting that "every person who should for hire, gain, or reward, act, represent, or perform any play or other entertainment of the stage, or part therein, if he shall not have any legal settlement where the offence should be committed, without authority by patent from the king, or license from the lord chamberlain, should be deemed a rogue and vagabond within the statute 12 Anne." This provision is now repealed by the 5 Geo. IV. c. 83, and players, as such, whether stationary or itinerant, are, at the present day, not amenable to the law as rogues and vagabonds.

The whole subject has now been placed under new regulations by the 6 & 7 Vict. c. 68, intituled "An Act for regulating Theatres." This statute (after repealing the numerous existing enactments) inflicts penalties upon any person who shall have or keep any house or other place of public resort in Great Britain, for the public performance of stage plays, without the authority of letters patent from the crown, or license from the lord chamberlain of the household, or license from at least four justices assembled at a special session, to be holden in the division where the proposed theatre is to be situated.

The jurisdiction of the lord chamberlain in this matter is defined by the Act as extending to all theatres (not being patent theatres) within the parliamentary boundaries of London and Westminster, and the boroughs of Finsbury and Marylebone, the Tower Hamlets, Lambeth, and Southwark, and also within those places where the sovereign shall occasionally reside. The jurisdiction of the justices extends generally to all places beyond these limits; but it is provided that no license shall be granted by either of these authorities, except to the actual and responsible manager of the proposed theatre for the time being, who is to give security for the due observance of such regulations as the authorities may impose; and also that no license shall be in force at the universities, or within 14 miles thereof, without consent of the chancellor or vice-chancellor. Penalties not exceeding £10 are moreover imposed on any person who for hire acts, or causes to be acted, any part of a stage play in any place not being a patent theatre or duly licensed.

The lord chamberlain and the justices may also, as to all theatres licensed by them, order the same to be closed, in case of riot or any public occasion whatever; and it is provided that one copy of every new stage play, and of every new act, scene or part, prologue or epilogue, or new addition to a prologue or epilogue, intended to be acted for hire at any theatre in Great Britain, shall be sent seven days previously to the lord chamberlain for his allowance, without which it shall not be lawful to act the same. The lord chamberlain is moreover empowered to forbid the representation or performance of any stage play, or any part thereof, in any theatre whatever, in any case where such a course shall appear to him advisable, whether for the preservation of good manners or decorum, or with a view to preserve the public peace; and it is enacted that every person who shall, for hire, act or present, or cause to be acted or presented, any new stage play, act, scene, part, prologue, or epilogue, or any part thereof, until allowed by the lord chamberlain, or contrary to his prohibition, shall incur certain heavy pecuniary penalties (up to £50, &c., each person engaged), and the theatre shall also forfeit its license.

Some years since numerous litigations were instituted by the proprietors of theatres against keepers of music halls, as to the law respecting their performance of stage plays. This circumstance led to the appointment of a parliamentary committee in 1867, and although no legislation on the subject followed, a more liberal system of licensing has since practically prevailed.

THEBA'ID, the territory or district belonging to Thebes, a term applied to the whole territory subject to the city of that name in ancient Greece. In a similar, though a much wider sense, the name is given to the whole of Upper Egypt, the modern Said, of which Thebes was the principal city.

THE'BAINE or **PARAMOR'PHINE** is one of the organic bases found in opium. It was discovered by Pelletier in 1835. It is obtained from the mother liquors in the preparation of narcotine; these are evaporated to dryness, and the residue is treated with acetic acid, and basic acetate of lead added; the precipitate is filtered off, and the excess of lead removed from the solution by sulphuric acid, and the filtered solution, which contains all the thebaine, is precipitated by ammonia. The crude thebaine thus thrown down is redissolved in alcohol, purified by animal charcoal, and the solution when evaporated deposits thebaine in colourless silvery scales. It is insoluble in water, but very soluble in alcohol and ether. It is also insoluble in potash, which distinguishes it from morphine. The formula is $C_{19}H_{21}NO_3$. It is extremely poisonous. It is coloured deep red by strong sulphuric acid. The salts of thebaine can only be crystallized from alcohol. The hydrochlorate crystallizes in rhombic prisms, having the formula $C_{19}H_{21}NO_3HClH_2O$. The chloroplatinate has the formula $2(C_{19}H_{21}NO_3HCl)PtCl_42H_2O$.

THEBES (Gr. *Thêbai;* Lat. *Thebæ*), an ancient town of Egypt, 450 miles from Cairo, in the Bible called No or No Ammon, was situated in the central part of Upper Egypt, which derived from this city the name Thebaid. The later Greeks called it *Diospolis megale* (Great city of Zeus). It consisted of two main parts, which were divided by the Nile, one occupying the eastern, and the other the western bank of the river, and each extending to the foot of the hills on either side. This gigantic city, whose ruins still excite astonishment, was believed to be the most ancient in Egypt. Its original circumference is stated to have been 140 stadia. Its most flourishing period appears to have been about 1600 B.C., when it had supplanted Memphis as the chief city of the Pharaohs, and was the capital of all Egypt. During that period it was for a long time the residence of the Egyptian kings, whose tombs are still extant in the rocks on the western side of the city, and extend even to the borders of the desert. During the invasion of Egypt by the Persians under Cambyses, B.C. 525, Thebes, like other towns, suffered very severely, especially in its private dwellings, which were for the most part constructed of wood; but its great architectural works have defied the slower influence of time, and even the ravages of barbarism. After this catastrophe the city never appears to have recovered its former greatness. During the time of the Ptolemies, when the seat of government was in the northern extremity of the country, Thebes appears to have been neglected by the Egyptian kings. In the reign of Ptolemy Lathuros, about B.C. 86, it revolted, and after a siege of three years was taken and plundered by the Greeks. As early as the time of Strabo, when its name had been changed by the Greeks into Diŏspolis, that is, "the city of Jove," and its circuit, which could still be traced, amounted to 80 stadia, the place was reduced to a number of villages, and what remained of the ancient city consisted chiefly of temples. Under the Roman dominion something appears to have been done to restore or preserve its ruins; but new calamities broke in upon it when Christianity was introduced into Upper Egypt, and the Christians in their religious zeal destroyed and appro-

priated to themselves as much as they could of the works of the ancient idolaters. The buildings and sculptures still extant are among the most ancient of any that exist in Egypt, and are the best and most genuine specimens of Egyptian art and architecture, for the greatest part of them were executed before Egypt had yet experienced the influence of the Greeks, that is, long before the Persian invasion (B.C. 525). The ruins, chiefly consisting of temples, colossi, sphinxes, and obelisks, occupy nearly the whole extent of the valley of the Nile, a space of 6 miles from east to west; and on the western side, where the memorials of the city end, there begins, as it were, the city of the dead, or the tombs in the rocks, with their paintings, which are still as fresh as if they had been made only a few days ago. In 1881 a great addition was made to our knowledge of the ancient Egyptian kingdom by the discovery of a long suspected tomb, which among many royal mummies contained that of Ramses II., the supposed Pharaoh of sacred history, and it is from these tombs that most of the mummies brought to Europe have been taken.

At Luxor, near the river, are the remains of a temple, still roofed, founded by Amenophis III. (Amenhotep), the entrance to which is through a magnificent propylon or gateway, consisting of two pyramidal moles, and the excavations of Professor Maspero in 1885 have exposed the building as second to none in its beauty and grandeur. In front of the propylon, which is covered with elaborate sculptures, stood two of the most perfect obelisks known to exist, one about 82 feet high, the other 76, and from 8 to 10 feet wide at the base. The latter was removed by the French and set up in the Place de la Concorde, at Paris, in 1836.

The remains of Karnak, about a mile and a quarter lower down the river, are also most wonderful. An irregular avenue of sphinxes, 2180 yards in length, connects the southern entrance of the village with the northern entrance of the temple of Luxor. Karnak is about 830 yards from the east bank of the Nile, and is surrounded by a wall of unburnt bricks, about 5300 yards in circuit, or more than 3 miles. The largest of the remains, a temple built by Osirtesen I., Sothis I., and Ramses II., is 1215 feet in length, and 360 feet in its greatest and 321 in its least width. The entrance to it fronts the Nile, with which it is connected by an alley of krio-sphinxes (sphinxes formed of the body of a lion and the head of a ram). This alley conducts to a propylon, without sculptures, 360 feet long and 148 feet high, with a great doorway in the centre 64 feet high; passing through this a large court is entered, having a range of pillars on the north and south sides, and a double row of loftier pillars down the middle, which terminate opposite two colossal statues in front of a second propylon. A flight of twenty-seven steps then leads to an enormous hall, which has been called the Great Hypostyle Hall of Karnak. It is 329 feet by 170 feet, and comprises an area of 57,000 square feet.

At Gournah, on the left bank of the river, which was anciently known as the Libyan Suburb, was situated the quarter called Memnonia, so called from containing the palace temple of the Memnonium or Rameseum, built by Ramses II., which, for symmetry of architecture and elegance of sculpture, is not surpassed by any monument of Egyptian art. One of its most remarkable objects, now unhappily reduced to fragments by the fury of the invader, was a stupendous syenite statue of Ramses II., seated, which, when entire, must have weighed 887½ tons, and stood 60 feet high. A pair of colossi, 47 feet high, representing Amenophis III., once the wonder of the ancients, still exist in a dilapidated state about half a mile further to the south. One is called the Vocal Memnon, from a sound which it emitted at sunrise, a fact variously explained. Not far off is a splendid group of temples at Medinet Abou.

THEBES, in Europe (Gr. *Thêbai*; Lat. *Thebæ*; modern Gr. *Thiva*), was, in Greek antiquity, the chief city of Bœotia. It was built on and around a hill between the Ismênos and Dirkê. The citadel occupied the height, and the greater part of the town stood in the valleys. Of its ancient buildings, monuments, and walls, only a few scattered fragments remain, and its topography is entirely uncertain. It is impossible to harmonize the ancient writers as to the position or even the names of its seven gates. Its territory (like that of its Egyptian namesake) was called the Thebaid. Thebes was equally illustrious in the mythical and the historical ages of Greece. Its two sieges and the fortunes of its royal houses were favourite subjects of tragedy, and it was for a time the ruling city of Greece. Tradition ascribed to Kadmus the foundation of the city, which was hence called Kadmeia, a name afterwards restricted to the citadel. From the five Spartoi, the survivors of the progeny of the dragon's teeth, the noblest Theban families claimed descent. The expulsion of Œdipus, and the successive sieges by the "Seven against Thebes" and by the Epigoni, were the principal recorded events before the Kadmeans were driven out by the Bœotians, a tribe from Thessaly. This occurred about sixty years after the Trojan War, according to Thucydides. The legislation of Philolaos, in the eighth century B.C., gave it an oligarchical instead of monarchical form of government, and made it the head of the confederacy of Bœotian towns. The first entirely certain event in its history is the revolt of one of these towns, Plataiai (about 519), which applied to Athens for protection. A war ensued between the Thebans and the Athenians, in which the latter were successful, and which initiated lasting enmity between the two states. Thebes lost credit by abandoning the cause of Greece in the Persian War, and fighting against the Athenians at Plataiai (479). The victorious Greeks appeared before its walls and compelled the inhabitants to surrender their "Medizing" leaders, who were immediately put to death. An Athenian invasion supplanted its oligarchy by a democratic government in 456, but in 447 the exiled aristocratic leaders returned, defeated the Athenians, and re-established the former government. During the Peloponnesian War the Thebans were more anti-Athenian than even the Spartans, but they joined the coalition against the latter in 395, and were the only portion of the allied army which was not routed by them at Coronea. The peace of Antalkidas (387) deprived them of their supremacy over the other Bœotian towns. The Spartans, who treacherously seized the citadel in 382, were expelled by Pelopidas about the close of 379, and were defeated by Epaminondas at Leuktra in 371. Epaminondas invaded the Peloponnesos, and established there the Arcadian confederation and the state of Messenia as political powers antagonistic to Sparta. But the Thebans sought in vain to establish their supremacy by a general treaty, and lost it after the death of Epaminondas at Mantinea (362). In 358 Athens wrested Eubœa from Thebes. In the sacred war (357–346) the Thebans were opposed to Athens and Sparta, and received support from Philip of Macedon; but when the design of the latter to conquer the whole of Greece became apparent they joined the Athenians against him. Philip, however, was victorious at Chaironaia (338). Thebes received a Macedonian garrison, and its leading citizens were put to death or banished. Alexander the Great razed it to the ground in 335, sparing only the house of Pindar, after which it never again formed an independent state. Kassandros restored the city in 315, and it was taken by Demetrios Poliorketes in 292 and 290. In the time of Strabo it had dwindled down to the condition of a village, but it was a flourishing town during the tenth and eleventh centuries. It was plundered by the Normans of Sicily in 1146. The present town is small and poor.

THEGN (often called *thane*, from *thegnian*, to serve, the same word as the modern high German *dienen*) is frequently, in conformity with its origin, translated *minister* in the Latin charters of the early English kings. In other cases its equivalent is *miles*, or *fidelis miles*. In this general sense it may be considered as nearly the same with the Norman *liege* or *liegeman*. The exact meaning of the term as a title of honour is involved in considerable obscurity. After the Conquest thegns (*thaini* or *taini*) are frequently classed with barons (*barones*): in the laws of Henry I. the two words are apparently used as synonymous; and where the English chronicler has thegns (*thegenas*), Latin annalists have commonly *barones*. These were the superior or king's thegns. The class of common or inferior thegns seems to have answered nearly to that of the *barones minores*, knights, or landed gentry. One of the few things that are tolerably certain with regard to the rank of a thegn is, that it implied the possession of a certain amount of landed property, and the obligation of military service to the *overlord*. Many lands are mentioned in Domesday Book as thegn lands (*terræ tainorum*), and it is probable that the dignity was sometimes attached to a particular estate. Any man possessed of 5 hides of land became a king's thegn, but not a noble. The grandson of a thegn became noble. The king alone had authority over his thegns. But bishops, ealdormen, &c., often had thegns, retainers of their own, and such retainers often had more than 2 hides of land. Thegns were among the members of the Witenagemot, or early English national council. They must not be confused with the king's *gesiths* or personal attendants—his "household," as we should term them.

THE'INE, see CAFFEINE, with which it is identical, except that it is obtained from tea (*Thea Bohea* and *Thea viridis*, natural order Ternströmiaceæ), instead of coffee. It is used in medicine in doses of 1 to 5 grains, and is tonic and stimulant. It has the effect of quinine with wine, with this advantage that it is not followed by depression.

THE'ISM, strictly speaking, denotes a belief in God as opposed to Atheism, but more generally it is used to designate a belief in God based upon what has been termed "natural religion" as opposed to the revealed system of Christianity. The various arguments by which Theism is supported against Atheism will be found under GOD, and a sketch of the theistic opposition to orthodoxy during the seventeenth and eighteenth centuries is given under DEISM. About the middle of the present century earnest attempts to found religious societies or churches upon a basis of theism as opposed to Christian theology were made both in England and America, many persons of eminence being enlisted in support of the new movement. One of the foremost of the champions of the theistic movement was Theodore Parker, whose "Theism, Atheism, and the Popular Theology" forms one of the best guides to the doctrines and ecclesiastical position of the theists, while further information may be found in the works of Professor F. W. Newman, Miss Frances Power Cobbe, and others. So far as external organization was concerned, most of the societies formed to work upon the new basis had but a short existence. In India, too, the societies of the BRAHMO SOMAJ, from which great things had been hoped, have of late years moved very far from the simple theistic position they at first assumed. In 1871, however, the prosecution of the Rev. Charles Voysey, vicar of Healaugh, for heresy, and his subsequent withdrawal from the Established Church, was followed by the formation of a Theistic Church in London, of which he was elected pastor. This has continued in existence up to the present, and its members hold regular services for worship at their church in Swallow Street, Piccadilly, and also carry on a propaganda by the publication of "theistic discourses" and the holding of mission services. It must be admitted, also, that although there are comparatively few theistic societies, the principles of theism are very largely adopted by many persons who yet continue to retain membership with churches which profess the doctrines of orthodox Christianity.

THEISS (*Tisza, Tisa*), the ancient *Tybiscus* or *Tibisis*, a river of Hungary, and the most important tributary of the Danube, is formed by the Black and White Theiss, which rise in the Western Carpathians, on the borders of Galicia (the former from Mount Czerna Gorna, the latter from Mount Pietros, near the source of the Pruth), and unite their waters in 48° 3′ N. lat., 24° 14′ E. lon. From this point the Theiss flows through a mountainous country to Tokay, receiving a great number of mountain streams on each bank. At Tokay it leaves the hill country and enters the great plain of Hungary to its entrance into the Danube on the left bank, 5 miles below Titel, nearly midway between Peterwardein and Belgrade. For the last 300 miles of its course it flows almost parallel with the Danube. Its banks are excessively swampy and boggy, except in the neighbourhood of Csongrad and other towns. The stream is extremely sluggish, but deep enough for small steamers. The navigation is slow, in consequence of the perpetual windings of the river, but these have been greatly reduced by numerous cuts, which reduce its course to the Danube by about 300 miles. The soil along the river banks is of the richest quality, but the pestilential atmosphere is fatal to colonization. At Tokay the river is 300 feet broad, at Szegedin 400 feet, and at its junction with the Danube 740 feet. Its length, including its various windings, is not less than 820 miles. The chief traffic on it is the downward conveyance of salt, timber, and agricultural produce. Its principal feeders on the left bank are the Szamos, the Körosz, the Marosch, the Aranka, and the Bega, called in its lower course the Karos; on the right the Bodrog, the Szajo, the Zagyva, and the Canal of the Emperor Francis. Of all European rivers the Theiss is said to abound most in fish. After an overflow they have been left in such quantities as to be used for feeding the pigs and manuring the ground.

THEL'LUSSON, PETER, owes his celebrity solely to the eccentricity of his will. Descended from a Huguenot family which had settled in Geneva, he established himself in England about the middle of the last century, and having accumulated a large fortune, he died on 21st of July, 1797. His ambition was to found in England two or three families whose territorial grandeur should overshadow the greatest landowners of the realm. To accomplish this object he did not hesitate to sacrifice the interests of his children and immediate heirs. By a will executed in 1796, after bequeathing to his sons and daughters a portion of his wealth, he devised the residue, consisting of real estate worth £4500 yearly and personal property to the amount of £600,000, to trustees for the purpose of accumulation. None of his living progeny were to touch this vast fortune, which was to be all invested for the benefit of the eldest male descendants of his three sons who should be alive when the last of Peter's then living offspring should have died. Calculations were made that this extraordinary arrangement would result in an accumulation of from £19,000,000 to £32,000,000, and but for its technical accuracy, in which no lawyer could find a flaw, the will would have been set aside on public grounds. Litigation, however, seized the document as lawful prey. Yet, on 25th June, 1805, the legality of its provisions was confirmed by the House of Lords. The legislature had previously expressed its repugnance to "the vanity, illiberality, and folly" of the posthumous miser, by passing an Act (39–40 Geo. III., c. 98) to restrain testators from directing the accumulation of property for a longer period than twenty-one years after death. Of the nine lives

isting in 1797, the last survivor died in February, 1856, when a new crop of lawsuits immediately followed. The question who were at that time the eldest male lineal descendants of Peter Thellusson was carried from one court of law to another, till it was finally decided in the House of Lords on the 9th of June, 1859. There it was decreed that Lord Rendlesham was legally the elder of his uncle, Arthur Thellusson (in personal age forty years his senior), because he was the direct heir and representative of the first Lord Rendlesham, Peter Thellusson's first-born son. The litigation on this famous will for a period of sixty-two years had so pruned the large fortune which was the subject of it, that the end which Peter had in view was effectually defeated.

THEME. See SUBJECT.

THEM'IS, a Greek divinity, was a daughter of Ouranos (Heaven) and Gê (Earth). She appears in Homer as a personification of the order of things sanctioned by usage or by law, and as the goddess who rules in the assemblies of the people. She is said to have been married to Zeus, and was worshipped with him at Thebes. At Olympia she shared the temple of the Horai (Hours), her daughters by Zeus. Astraia, goddess of Justice, was another of her daughters by Zeus. Some poets also make her mother of the Hesperids.

THEMIS'TOKLES, the celebrated statesman of Athens, was born about 514 B.C., and was the son of Neoklês, an Athenian of moderate fortune. His mother was a Thracian woman of the name of Abrotonon. After the banishment of his rival Aristeidês the Just in 483 B.C., Themistoklês became the political leader in Athens, and two years afterwards (481 B.C.) he was elected Archôn Eponumos. Athens being at that time at war with Ægina, Themistoklês counselled that the fleet should be increased so as to be a match for that of the enemy; but his real design was not so much to conquer the Æginêtans as to render Athens supreme among the Grecian states by making her capable of resisting the dangers which he foresaw were likely to come from Persia. The event soon justified his policy. When the vast armament of Persia appeared it was only the enormous influence of Themistoklês that kept the Greek allied fleets from shameful flight. He induced the Athenians to trust to an oracle predicting victory to the town with wooden walls, which he said meant ships: and as for the allies he prevented their departure by the device of a deceptive message to the Persians, who were led by it to attack instantly. The first encounter between the Grecian and Persian fleets took place off Artemision on the same days on which Leonidas and his 300 so heroically kept the pass of Thermopylæ (480 B.C.) Soon after followed the battle of Salamis, by which, the enemy's fleet being defeated and dispersed, Greece was delivered from the fear of the Persian yoke. After this Themistoklês persuaded the Athenians to fortify their city, disregarding the remonstrances of Sparta (479 B.C.) But his influence declined from the time of the overthrow of Xerxes, and in 471 B.C. he was ostracized from Athens. It is related that his father, perceiving the early ambition of his son, pointed out to him some old galleys thrown on the shore to rot and decay, and told him that this was the way "the many" treated popular leaders when they were no longer of any use—a lesson which he must now have bitterly remembered. After his banishment he retired to Argos; whence, however, he was forced to flee, and took refuge in Persia, where he died, or, as some say, destroyed himself, 449 B.C. "Themistoklês," says Thucydides, "was the strongest example of the power of natural talent, and in this respect is particularly worthy of admiration; and by the force of his natural capacity, and the quickness of his determination, he was the most efficient of all men in promptly deciding what was to be done." But it may reasonably be doubted whether, with all his high intellectual qualities, he was an honest man. From opening manhood his ambition was to be the first man in Athens, and to make Athens the first among the Grecian states; and he had no nice scruples about the means by which his end was to be accomplished. The rumour that he had promised to lead the new king of Persia to the conquest of Greece, and the certain fact that he received from the hereditary enemies of his country three towns yielding a princely revenue, show badly for his fame. Nevertheless Dr. Adolf Bauer in 1883 produced a very learned little treatise (published at Merseburg), having for its main object the vindication of the fair name of Themistoklês; and much doubt has also been thrown upon the current accounts, none of them contemporary and all written in hostile times, by Rev. Sir George W. Cox in his unfinished "History of Greece" (1874). There was a tradition that a certain tomb in Peiraios, the port of Athens, held his remains, brought thither secretly by friends at his last request.

THE'OBALD, LEWIS, the editor of Shakespeare, and hero of the early editions of the "Dunciad," was the son of a prosperous attorney of Sittingbourne in Kent, where he was born about 1692. Early in life he devoted himself to literature. In 1711 his "Persian Princess" was performed in Drury Lane, and his scholarship procured him the patronage of Bernard Lint, the eminent publisher. For him, in 1713, Theobald translated Plato's "Phaidôn," and in the following year he signed an agreement with him to execute a translation of the Odyssey, of which only a small portion, in 1716, was published. This circumstance may have helped to embitter Pope against him. He had published many works, including translations from Sophokles and Aristophanes, a "Life of Raleigh," and a number of plays, when, in 1725, appeared Pope's edition of Shakespeare. In the following year Theobald published his "Shakespeare Restored; or specimens of blunders committed and unamended in Pope's edition of this poet"—a work of which the title sufficiently explains the object. Some punishment was administered to the assailant in the "Treatise on the Bathos" (in the "Miscellanies," by Pope and Swift, 1727); but a still more terrible revenge was taken when, in 1728, the "Dunciad" appeared with "piddling Tibbald" for its hero. Nothing daunted, Theobald pursued his course. In 1728 appeared his "Proposals for publishing Emendations and Remarks on Shakespeare," which were so well received that he resolved on an edition of Shakespeare of his own. It was published in 1733, and at once eclipsed Pope's for all real students of the great dramatist. For his editorial labours Theobald was paid £652 10*s*., and no fewer than 12,860 copies of his Shakespeare were printed. Dr. Johnson called Theobald a man "of heavy diligence, with very slender powers." But in the then state of Shakespeare's text, "heavy diligence" was much required, and, beyond this, many of Theobald's happy emendations have been accepted and remain. He had much aid from others, especially from Warburton, and his Shakespeare is certainly the best of the early modern editions. He was among the first to collect the old English dramas, and to make them useful in illustrating Shakespeare's text. In 1741 Theobald was replaced by Cibber in the post of dishonour in the second version of the "Dunciad.' In the following year both the satirist and the satirized were in their graves, for Theobald died, not long after Pope, on the 18th September, 1744.

THEOBRO'MA is a genus of plants belonging to the order STERCULIACEÆ, the species of which yield the cocoa of commerce. There are about ten species, natives of tropical America. They are small trees with large entire leaves and solitary or clustering flowers, growing from the sides of the branches and stems. The calyx is deeply five-parted; the petals are five, concave at the base and extended into a strap at the apex; the stamens are ten, united at

the base into a cup, five being sterile and alternate with the petals, and five opposite to them, and bearing two anthers each; the style is thread-like, terminating with a five-cleft stigma. The fruit is a large pentagonal five-celled capsule, with a thick, tough, almost woody rind. Each cell contains numerous seeds embedded in a soft butter-like pulp.

The most important species, and the one which furnishes most of the cocoa of commerce, is the Cacao tree (*Theobroma cacao*). It is a small tree, generally about 16 or 18 feet high, with many branches, large oblong leaves, tapering at the apex, and clusters of flowers, with the calyx rose-coloured and the petals yellowish. It is indigenous in tropical America, and is generally found at a height of 600 feet above the level of the sea. It is, however, extensively cultivated in the West Indies, especially in Trinidad and Grenada, and in the tropical parts of Asia and Africa. The Mexicans call the tree *chocolalt*, and hence our word *chocolate* for the prepared seeds. The fruits are large, from 6 to 10 inches in length, and from 3 to 5 inches in breadth; they are oblong in shape, with ten elevated ribs running longitudinally, and yellowish in colour when ripe. Each fruit contains from 50 to 100 seeds; the pulp in which these are enveloped has a sweet and not unpleasant taste, and is frequently eaten where the tree is grown. The trees are evergreens, and bear fruit and flowers all the year through, but the usual times for gathering the fruit are in June and December. The cotyledons of the seeds contain a large quantity of oily albumen, which has an agreeable flavour, and on this account they are not only used as a principal article of diet by the natives of the countries in which they grow, but for the same purpose throughout the civilized world.

In preparing for use, the pods containing the seed are gathered when ripe, and after having lain for a day and a night are opened, and the seeds are submitted to what is termed the "sweating" process. They are first placed on a sloping floor or in baskets, so that the chief part of the pulp in which they are enveloped may drain off, and are then shut up in a close box, and left for twenty-four or forty-eight hours, according to the season and weather, after which they are turned out in the sun to dry. Upon a nice performance of the sweating process, which may be likened to malting, the value of the cocoa greatly depends. When quite dry the seeds are packed in barrels or bags, and are ready for shipment. The process of roasting is effected in a metal cylinder, with holes at each end, through which the vapour generated is allowed to escape. When the aroma is sufficiently developed the seeds are cooled, and then passed to a "kibling mill," which removes the husks and skins from the "nibs."

Cocoa nibs are the bruised roasted cotyledons of the seeds freed from husk and membrane. They are the simplest form in which cocoa can be used, but require an inconveniently long time fully to extract their essence. Flake cocoa is formed by grinding the nibs in a mill consisting of two cones, working one inside the other. No form of simple cocoa is really soluble, but by the addition of easily diffusible substances an article is produced which is capable of forming an emulsion with boiling water. Sugar and sago or arrowroot are the diluents used by respectable makers, and a moderate amount of these cannot be regarded as adulteration, for it is impossible to render cocoa soluble, or rather emulsive, without the addition of some diffusible substance. All kinds of starches, however, coloured with Venetian red, and even chalk and plaster of Paris to increase the weight, are sometimes added. That known as Homœopathic Cocoa is made soluble with arrowroot, but without sugar.

Cocoa is readily prepared from the soluble varieties by simply pouring boiling water upon the powder. From cocoa-nibs or flaked cocoa, the beverage is prepared by first pouring boiling water upon them, and then allowing the mass to simmer from four to six hours. The cocoa must not be allowed to boil, or a coagulum will be formed which cannot be dissolved in water,

No warm drink that we take approaches cocoa in its nutritive character, because, while performing to a certain extent the exhilarating work of coffee or tea, it contains 20 per cent. of albuminous matter, and presents to the stomach a very considerable quantity of nitrogenous and carbonaceous matter; the advantage being also due partly to the fact that cocoa is taken in the form of an emulsion instead of an infusion or decoction. A peculiar concrete oil called cocoa butter is an important constituent, forming more than one-half the weight of the seed. It may be obtained by expression, acts as an anodyne, and is excellent for ointments.

Chocolate, a favourite form of cocoa, is obtained by grinding the nibs in a mill consisting of stone or metal rollers, which are usually heated either by charcoal fires or by steam, so as to soften or melt the natural fat. The warm smooth paste which passes from the mill is then placed in a mixing mill and incorporated with refined sugar, and usually with vanilla, cinnamon, or other flavouring substances. The trituration is continued until the whole paste is converted into an entirely homogeneous mass, which is finally shaped by moulds into blocks, loaves, tables, lozenges, &c. The chocolate may then be taken in the solid form, or made into a beverage; or, combined with sugar, it is made into various articles of confectionery.

The active principle of cocoa is *theobromine*, an alkaloid greatly resembling caffeine, the active principle of coffee and tea.

On importation into the United Kingdom, cocoa is charged 1*d.* per lb. duty, chocolate 2*d.* per lb., and husks and shells 2*s.* per cwt. The quantity imported in 1886 was 25,386,439 lbs.; but that entered for home consumption was only 15,165,714 lbs., the remainder being exported to Spain, Germany, France, and Holland.

The following is a list of the principal kinds of cocoa in the order of their commercial value:—Caracas (from whence the best quality is imported), Surinam, Trinidad, Grenada, Jamaica, Dominica, Guayaquil, Venezuela, Bahia, Brazil, St. Lucia. See CACAO.

THEOBRO'MINE is an organic base found in cacao beans (*Theobroma cacao*, natural order Byttneriaceæ). It is obtained by treating the powdered beans with water, and after removing the extraneous matters by acetate of lead, the excess of lead is removed by sulphuretted hydrogen, the solution is evaporated to dryness, and the residue boiled with alcohol, which deposits the theobromine on cooling. It crystallizes in minute trimetric crystals, which sublime without decomposition at 290° C. (554° Fahr.) It is very bitter, and is only sparingly soluble in hot water, alcohol, and ether. The formula is $C_7H_8N_4O_2$. It is a weak base, forming unstable crystalline salts. The hydrochlorate has the formula $C_7H_8N_4O_2HCl$. The formula of the chloro-platinate is $2(C_7H_8N_4O_2HCl)PtCl_44H_2O$. It is used in medicine in doses of 1 to 5 grains as a tonic and stimulant, the same as caffeine, with which it is closely allied, being viewed chemically as dimethyl-xanthine, caffeine being trimethyl-xanthine; both can be prepared directly from xanthine, and therefore indirectly from the guanine of guano.

THEOC'RITUS. See THEOKRITOS.

THEOD'OLITE, a surveying instrument for measuring vertical and horizontal angles and taking levels, combining the uses of the ordinary transit, the quadrant, and the level. In the American form of the instrument, the telescope turns over and the vertical angles are read on a graduated circle. In the English form the vertical angles are read on a semicircle beneath the telescope and level; the telescope therefore cannot turn over, but is reversible.

The American form is preferable, by reason of the greater facility and precision of the adjustments; but the English form is the steadier and more reliable. See the article SURVEYING and accompanying Plates, which contain a representation of the usual form of the instrument.

THEODO'RA, the famous empress-consort of Justinian, has afforded countless essayists a moral and story-tellers a theme. Her strange career lends itself alike to satirist and dramatist, and the greatest actress of modern times has found in Theodora her greatest scope for the display of her unrivalled versatility. Even in the pages of historians Theodora's life is a startling romance.

She was the daughter of the keeper of wild beasts in the public amphitheatre at Byzantiun, who died when Theodora was a child of six. As the office was not given to the widow, the latter sent her children into the amphitheatre on a festival day, that their appearance might excite compassion. The faction of the blues took up their cause. The great faction of the greens, which divided the supremacy of the city with its rival, successfully opposed their implied claim. Theodora never forgot this, and in her later times of power the greens suffered. (Green and blue were originally colours of the circus, which came to be adopted also as political badges.) Theodora grew up into a marvellously beautiful girl, and acted subordinate parts to her elder sister on the stage. The usual result followed, and her license and extravagance were matters of public notoriety.

A vision came to this abandoned woman that she was destined to please a prince of the imperial house. She at once discarded her lovers and returned from Asia to Byzantium, assuming a demeanour as rigidly decorous as her previous life had been shameless; she lived in a small house, and spun for a living. The opportunity she carefully sought soon came, and the Emperor Justin's nephew, Justinian, was allowed to see her, and was quickly enthralled by her beauty and great cleverness. She soon obtained absolute dominion over him, the more that she affected a remorseful repentance. His mother and friends in vain pleaded a law forbidding the marriage of one of senatorial rank with a woman of impure life. The infatuated prince caused a decree to be passed annulling the law, and married Theodora (525). When he came to the throne in 527 he had the oaths of allegiance sworn to her jointly with himself as coequal in the sovereignty, and the ex-courtesan was solemnly crowned by the head of the church.

The empress affected a great seclusion, showed herself rarely in public, and gave out that she worked hard at public affairs. The memoirs of the time accuse her of continuing her amours in the secrecy of her retirement, and of running the streets of the capital in disguise when she was thought to be in privacy in her rooms overlooking the Bosphorus; but with a woman so hated as she was, much latitude must be allowed in any account of her not absolutely corroborated. What is certain is that she was the moving spirit of the age, and was its fitting representative: one of the proudest, cruellest, most bigoted, and most avaricious, as well as one of the most beautiful and clever women who ever lived. She would make the greatest dignitaries of the empire wait her pleasure in a darkened ante-room before she would admit them to kiss her lovely bare feet, the necessary preliminary to an interview. None dare stand in her presence unpermitted. When addressing her it was the etiquette to veil the eyes with the hand, as if overcome with the brilliancy of her presence. Yet the same person to whom these semi-divine honours were paid would have the unlucky wretches whom her spies had caught tortured in her presence in her own private prisons, and her usual instructions to an envoy finished with an injunction to use diligence, "or your skin shall be flayed from your body." She had a boy (her only child) by one of her many lovers, who educated the child in Africa, only imparting to him the secret of his birth when he himself lay dying. The happy youth hastened to Byzantium to make himself known to his imperial mother, but he was never more seen nor heard of after his entrance into the palace.

Hardly had Justinian begun to reign when the disputes of the circus factions flamed into open civil war. The emperor was preparing to fly into Asia. It was Theodora alone who prevented the court from flying. "I would disdain to fly," cried she; "they who have reigned should never survive the loss of dignity or dominion;" and by her indomitable courage she restored the tottering throne, appealing to her favourite blues, and winning the doubtful soldiery to obedience. Thirty thousand greens perished on that day, and the base-born empress saved the empire. Nothing was too good for her after this. Every Act bore her name. Even the election of a Pope (Vigilius in 537) was of her arranging. Her journeys for health were accompanied with lavish alms and benefactions, palaces were turned into charitable institutions in her name, prayers were continually offered for an heir, and notwithstanding that no heir ever arrived she maintained her ascendency in the councils and in the heart of Justinian to the last. When she died in 548, of an internal cancer, the grief of Justinian knew no bounds.

THEODO'RA, Empress of the Eastern or Byzantine Empire, was born about 810, and married the Emperor Theophilos in 830. The occasion was sufficiently peculiar. The emperor could not settle upon a wife: he therefore caused the daughters of all the principal nobles to appear before him ranged in two lines, and from these he chose out a few for final selection. Conversing with them he was met by artifice and wit in most cases, but by modest reticence in the beautiful Theodora. She was left regent, and guardian of the Emperor Michael III., in 842; and her great work was permanently to restore the worship, or rather the adoration, of images, which accordingly remains the practice of the Greek Church to this day. [See ICONOCLASM.] The court and the empire were models of management under this admirable princess, but after thirteen years of rule her brutal and dissipated son, on attaining his majority, broke through all her wise restraints, dismissed her from his counsels, and even confined her in a convent; all which she bore with the exemplary quiet fortitude which always distinguished her. She died in 857.

THE'ODORE, a Greek monk of Tarsos, consecrated archbishop of Canterbury in 668, was appointed by Pope Vitalian by reason of the death of Wighard, an English priest, who having been nominated by the kings of Northumbria and Kent, had proceeded to Rome for consecration. Theodore was of the Greek Church, and had not adopted the tonsure, which he assumed, however, before reaching England. His name was long remembered in connection with his "Penitential," the first book of the kind that appeared in the West. He died in 690, after thoroughly founding and organizing the hierarchy in England. [See SYNOD OF WHITBY.] His extant works were published at Paris in 1677, in two vols. 4to.

THEOD'ORIC I., King of the Visigoths, son of the great Alaric, was elected successor of King Wallia in 419. Immediately after the accession of Valentinian III., having invaded Gaul, he besieged Arles. Aëtios, the Roman commander, relieved the town, and then entering into treaty with the Goths they turned their united arms against a common enemy, the Vandals. In 450 Attila, at the head of his Huns, invaded Gaul, when the Romans once more united with the Visigoths, and encountered the invaders at Châlons in 451, where in a sanguinary battle, in which 160,000 men were left dead upon the field, Attila was defeated. Theodoric was killed at the beginning of the engagement.

THEODORIC II., King of the Visigoths, succeeded his

father by murdering his brother Thorismond, in 452. He ruled the greater part of Gaul and Spain, and was as much of a patron of literature as the times allowed. In 466 he fell in his turn by the dagger of a third brother, Ewric.

THEOD'ORIC THE GREAT, King of the Ostrogoths, and later on King of Italy, was the son of King Theodomir, and born in 455. In his youth he had been educated as a hostage at the court of Constantinople, but he returned to his father in 472, and succeeded him at his death in 475. Having formally received the government of Italy from the Emperor Zênô, to whom he had rendered some important services, Theodoric crossed the Alps with a large Gothic army in 489, and defeated Odoacer, who then held the Italian kingdom, near the ruins of Aquileia. The victorious Goth followed up his advantage by attacking Ravenna, to which Odoacer, after losing three several battles, had fled with 20,000 men. After a siege of three years Ravenna was surrendered, and Theodoric, notwithstanding his promise to spare the life of the captive Odoacer, ordered him to be put to death in his own palace. On the death of the latter Theodoric became king of Italy, and was formally acknowledged as such by the Emperor Anastasios, Zênô's successor. He fixed his residence at Ravenna. During his reign internal tranquillity was preserved, and various additions were made to the Italian kingdom. He restored the walls of Rome, repaired the aqueducts and public baths, built a cathedral at Ravenna, and palaces at Verona and Pavia. He was a remarkably great-souled man, and a wise, just, and tolerant sovereign. The cruel deaths of Symmachus and of the philosopher Boethius alone obscure the glory of his reign, and he is reported to have felt such remorse for them as to have sunk, conscience-stricken, to the grave. [See SYMMACHUS.] He died in 526, in the seventy-second year of his age. His ashes were deposited in a porphyry vase, still to be seen at Ravenna.

THEODO'RUS I., Pope, was a Greek by birth, and was raised to the see of St. Peter in 642. He rejected the so-called *Typus* of the Emperor Constans, by which the latter imposed silence respecting the doctrine of the Monothelites. Theodore was the first pope to whom was given the title *summus pontifex*, and the last whom a bishop (Victor of Carthage) called brother. He died in 649.

THEODORUS II., Pope, was a Roman by birth. He was elevated to the dignity in 898, but he lived only twenty days thereafter.

THEODO'SIOS THE GREAT, Emperor of Rome in the East, was descended from an illustrious Spanish family, and the son of that Theodosios whose exploits in Britain and Africa shed such lustre on the reign of Valens and Valentinian. He was born in 345, and educated by the most skilful preceptors in all the learning of the time, while he was instructed in the art of war by his father. Theodosios soon so greatly distinguished himself that he was raised to the rank of duke, and received an independent command. In 379 the Emperor Gratian found that he was unable to resist unaided the tempest of barbarians which threatened to burst over the provinces, and invested Theodosios, then but in the thirty-third year of his age, with the purple, and gave him the Empire of the East. By combined prudence and valour the newly-chosen emperor freed the eastern provinces from the pressure of the Gothic invaders, concluding a treaty with them at Constantinople in 381. That treaty implied their virtual submission. In 389 Theodosios entered Rome in triumph, after quelling the insurrection of Maximus and restoring peace to the Western Empire. Two pieces of savagery disgrace the somewhat imposing character of Theodosios. The first was the ferocious punishment of Antioch, which was plundered and reduced to the rank of a village in 387, for an insult to himself and his family, their statues being overthrown in a riot. He afterwards pardoned the city and restored its rank. Three years later, while he was absent in Italy, there was a serious riot at Thessalonica. The brutal emperor resolved to exterminate the inhabitants, and sent orders to surround the circus with barbarian troops, whilst the games to which he had invited all the chief inhabitants were proceeding; then at a signal all within the walls, to the number of 7000, or as some historians say, even 14,000, were to be killed. This fearful massacre, which was actually carried out, took over three hours to accomplish, and is, perhaps, the greatest crime in history. When the emperor presented himself at the Cathedral of Milan, after the news had arrived, he was met at the door by St. Ambrose and sternly forbidden the holy precincts as a man of blood. The terrible anathema of the good archbishop crushed the tyrant, and he laid aside all imperial insignia to kneel and beg the divine pardon for his sins before all the congregation. On this, after eight months' delay, he was readmitted to the church, and poses as one of its most orthodox members. Apart from church prejudice in favour of so illustrious a penitent, it is difficult to imagine a more infamous monster. But the great Arian heresy was yet formidable, and the rigid Catholicism of Theodosios made almost anything seem pardonable in so orthodox a prince and so vigorous a persecutor of heresy. It was in this reign that paganism was formally abolished. Symmachus and the old-fashioned Romans had prayed Valentinian that the statue of the goddess of victory, removed by the Christian Emperor Gratian, might be restored to the senate hall, but the authority of St. Ambrose was sufficient to prevent this being done. Theodosios went further. He had it debated in the Senate when he had become master of Italy, whether the worship of Jupiter or of Christ should be that of the Romans, and the inevitable verdict was solemnly recorded; though, to the honour of paganism be it said, there was a considerable minority vote. He then used every form of pressure to induce the ancient Roman families to become converts. The same policy was pursued all over the empire. In 389 a formal mandate ordered the destruction of the worship of Serapis at Alexandria, and this was accomplished with such extravagant zealotry that the famous library which formed part of the Serapeion was pillaged or destroyed, and many priceless works of antiquity thus passed away for ever. Finally, in 390 an imperial edict forbade the offering of sacrifice under pain of high treason. The poor peasants (Gr. *pagos*, a village) eluded the edict by holding convivial meetings, where beasts were slaughtered in the open air and hymns sung to the old gods. These pathetic struggles were terminated by a law making it death to use divination by entrails or to pour libations of wine, &c. It was for the benefit of mankind that paganism should die out, but its death was in actual fact a cruel murder, and moreover a needless anticipation of the gentler methods of time, before whom Jupiter would equally well have disappeared in a very few years. The cruelty of Christian persecutions raises our pity, but the cruelty of these pagan persecutions passes almost unnoticed, except by a few scholars, who read of them in Zosimos and other nearly contemporary writers.

Theodosios supported Valentinian II. as titular sovereign of Italy, though himself the actual ruler of West as well as East, until the murder of that prince in 392, followed by the usurpation of Eugenius. Theodosios then appeared at the head of an army and defeated and killed Eugenius, thus becoming the master of the whole Roman world (394). He was the last monarch who held the undivided dignity. At his death, four months later (January, 395), worn out by private excesses and indolent habits, the Empire of the West passed to his son Honôrios (Honorius), and that of the East to his son Arkadios (Arcadius).

THEODOSIOS II. or the Younger, was the grandson of Theodosios the Great. His long reign (408–450),

during which his sister Pulcheria exercised the supreme power, was one of almost uninterrupted peace. The great legal compilation, called the Theodosian Code, was made in this reign and published in 438. The best edition is by Hänel Bonn (1837).

Theodosios III., Byzantine Emperor, reluctantly accepted the dignity in 715 and retained it little more than a year, being dethroned by Leo III. Theodosios spent the remainder of his days in a monastery.

THEOG'NIS OF MEGARA, an elegiac and didactic poet, flourished from about 570 to about 490 B.C. His native country was then distracted by the struggle of the oligarchic against the democratic faction. Theognis, nobly born and sympathizing with his own class, naturally took part with his own rank. He was in consequence banished from Megara, and his verses often indicate that he suffered severely under the sorrows of exile. Scarce anything more can be said of Theognis personally; but we still possess a considerable collection of verses under his name, which has occasioned much literary controversy. The truth appears to be that Theognis is one of the earliest Greek didactic poets of whom we have any remains—Hesiod, of course, excepted. Hence numerous poems of various antiquity were falsely ascribed to him. The collection which we now possess under his name is at any rate a very interesting body of didactic verse, extending to nearly 1400 lines. The best editions are those of Bekker (Leipzig, 1827), Orelli (Turin, 1840), and Gaisford (Oxford) in his collection of the minor Greek poets.

THEOK'RITOS (Lat. *Theocritus*), a celebrated Greek pastoral poet, was, according to the well-known epigram prefixed to some of the editions of his poems, the son of Praxagoras and Philinna. He was a native of Syracuse; but nothing is now known of the precise time either of his birth or death, and even of the history of his life we possess very little certain knowledge. We know, however, that he flourished in the earlier part of the third century B.C. This is made certain by the fact of his sojourn at Alexandria, where he enjoyed the favour and patronage of Ptolemy Philadelphos. It was probably while residing in that city that he made the acquaintance of the poets Philetas, Asklepiadês, and Aretos, all of whom are mentioned in his poems. From Alexandria Theokritos must have returned to Syracuse, as the sixteenth idyll, which is in praise of Hierôn II., was evidently written there, and we know that the king did not begin to reign till 270 B.C. From this poem we can gather that he was, like so many other poets since his day, no stranger to disappointment and neglect. Theokritos may be called the creator of bucolic poetry; he first reduced it to such a form as to constitute it a branch of regular literature. His thirty *eidullia* (from *eido*, I see, *i.e.* pictures, or things seen), which we alter to "idylls," many of which are in dialogue, are essentially of a dramatic and mimetic character. They are pictures of the actual life of the Sicilian people, herein differing from the most of pastorals which have been subsequently produced. In these we generally have descriptions of some imaginary Arcadia, and of modes of life which never existed. But in Theokritos everything is natural and real, and his pictures are besides drawn with an inimitable sweetness, naïveté, and grace. A few epigrams in the Greek anthology bear the name of Theokritos. His favourite dialect, highly characteristic, is the later or softened Doric, largely modified, however, by admixture of more refined Greek. The best of the modern editions are those of Reiske, with a Latin translation, the Greek Scholia and notes, 1765, and E. F. Wustermann (Gotha, 1830). There are English versions by Creech (1681), Polwhele (1786), and (best of all) Calverley (1869).

THEOL'OGY (Gr. *theos*, God, and *logos*, discourse), the science which treats of God and of religion. The name *theologos* was given by the Greeks to the authors of theogonies (as Orpheus and Hesiod), and to those who wrote poems (as Empedoklês) or philosophical treatises (as Pherekudês) on divine things and the origin of things through the gods. A distinction was early made, as by Varro, between mythical theology, a knowledge of myths and legends concerning the deities of the classic poets; physical theology, the investigations of philosophers on the origin of the world; and civil theology, a knowledge of the rites and ceremonies pertaining to public worship. The term theology does not appear in the New Testament, though we can see from the epistles that the need of formal statements of doctrine had become apparent, and was to some extent being supplied; but the Greek Christians used the term *gnôsis*, knowledge, to designate what may be called speculative theology, as distinguished from the simple practical faith of ordinary believers. The ecclesiastical writers of the third and fourth centuries used the word, but applied it chiefly to doctrinal treatises on the nature of the Godhead, or on the doctrine of the church concerning the Trinity. In this sense the evangelist John and Gregory of Nazianzen were termed theologians. Somewhat later the term was used by Theodoret, Maximus, and others of the whole system of Christian doctrine, but its most common signification remained the doctrine of God. Abélard, by his "Theologia Christiana," was the first to apply the term to the entire science of the Christian religion, which signification it has since retained. With regard to the foundations upon which the science of theology rests, a division is usually made between the elements which rest upon rational arguments only, and those which are derived from the Scriptures and the Church, the former being termed natural theology, and the other Christian or revealed theology. Viewed as comprising the whole of religious science theology may be divided into four branches—historical, exegetical, systematic, and practical or moral theology. These are again variously subdivided, and several auxiliary sciences are connected with them. Thus historical theology embraces the history of the church, of the councils, of heresies, and what is of equal importance, the study of the development of Christian doctrines. To exegetical theology belongs the interpretation of the sacred Scriptures, including the history of the various books, their authenticity, criticism of the text, and hermeneutics, or the science which teaches the right rules of intrepretation.

Systematic theology, also called merely theology among Protestants, comprises dogmatics or the system of Christian doctrines, the system of Christian ethics, and the study of the doctrines professed by the several religious denominations. Practical theology includes homiletics, catechetics, liturgies, ecclesiastical law, &c. Polemics and apologetics, which are often treated as separate branches of theology, in reality belong to several of the above-named divisions at the same time. In Roman Catholic schools a different division is made, and the different branches of the science are grouped together under the headings of dogmatic and moral theology. Dogmatic theology, which includes the exposition and demonstration of Christian doctrine, bases its proofs on Scripture and the traditions of the church. Moral theology treats of divine and human law as the rule of our actions. It aims at determining the true sense of the law and the gospel, discusses virtues and vices, examines the principles of justice and the foundations of injustice, points out what is needful, permitted, or unlawful, and teaches all Christians their respective obligations in all states, conditions, and offices. Moral theologians are often called casuists, from their treating *ex professo* of cases of conscience.

Until the time of Abélard little attention was paid to comprehending theology in its totality, and to establishing the connection of the branches with each other. Although nearly all the theologians of the middle ages whose writings are extant belonged to the same church, yet they were

divided into two fundamentally different schools, the scholastics and mystics. Scholastic theology reduced all doctrinal matters into one body, so co-ordinating them that one question explained and completed another, binding them into a connected and systematic whole. It observed in its every demonstration the strict process of syllogistic reasoning, making use of the admitted principles of metaphysics, and thus aimed at conciliating faith with reason and religion with theology. The theologians of the mystic school have been noticed under MYSTICISM. The theologians of the churches which grew out of the Reformation of the sixteenth century followed in their treatment of their science either the scholastics or mystics, though the name of the former was discarded, both by their Protestant and Roman Catholic followers. A new era in the history of theology was inaugurated by the philosophy of Kant, who fully developed and systematized a new theory of Christian theology, which more or less made the belief in a religious doctrine dependent on its demonstrability by reason. This view of theology, commonly known as rationalism, gained the ascendency in several of the Protestant churches of Germany, its opponents, who defended the Bible as the absolute rule of faith, being known as supranaturalists. The subsequent history of theology may be regarded as a contest between these two systems, which is not yet ended. The present century has witnessed some most important developments of Scriptural criticism, which, after being fiercely opposed by the supranaturalists, have resulted in the placing of the Bible in an entirely new position in respect to theology. Opinions differ as to the extent of this change, but its reality is now admitted by the most conservative of Protestant theologians, and it is recognized without admission by the principal teachers of the Roman Catholic Church. Still more recently the science of comparative theology has been inaugurated, and its influence is extending every year. It is too early yet to prophesy what its conclusions will be; but according to its most able professors the principle of comparison, which has already wrought such wonders in other branches of science, is destined to effect a revolution in theology which will put all former changes in the shade, and which will not only place the science upon a new basis, but will open out for it entirely new phases of development.

THE'ON, the Elder, a mathematician, lived in Smyrna in the course of the second century. He was the author of a treatise, still extant, on "those parts of mathematics which are useful in reading Plato," and comprehending arithmetic, geometry, astronomy, and the theory of music. The best edition is by Gulder (Leyden, 1827).

THE'ON, the Younger, an Alexandrian mathematician and astronomer, father of the famous HYPATIA, flourished in the course of the fourth century. He edited and commented the works of some older mathematicians, especially Aratos, Euclid, and Ptolemy. Of his own writings the most interesting that has come down to us is a description of the solar eclipse in 365.

THEOPHRAS'TOS, the favourite pupil of Aristotle, and his successor as head of the Lyceum, was born at Eresos, a town in the island of Lesbos, probably about 374 B.C. He came to Athens in early life, and studied first under Plato, and afterwards under Aristotle. On the death of Aristotle in 322 B.C., Theophrastos, by the will of the philosopher, who likewise left him his library and manuscripts, was nominated president of the Lyceum, for so the place was called in which Aristotle had promulgated his philosophy. He numbered the comic poet Menandros (Menander) among his disciples, and seems to have had great sympathy with the drama. This quality of his genius is inferred from his work entitled "Ethical Characters"—one of the few which have come down to us —a work abounding in delineations characterized rather by the strength than by the delicacy of their colour; but which are certainly not deficient in comic vigour, and are moreover curious as indications of the morals and manners of the times. The French writer, La Bruyère, has translated and imitated these characters of Theophrastos. The only other extant writings of Theophrastos are a treatise on "Sensuous Perception and its objects," and treatises on plants and on stones, but the number of works he wrote was very large, as he set himself to elucidate every point in Aristotle's works which was not clear. Theophrastos died 287 B.C., at the age probably of about eighty-seven. He complained on his deathbed of the shortness of his life, and lamented that he was hurried away just when he was beginning to discover the solution of the problems on which he had been working. The best editions of his works are by Schneider (1818–21) and by Wimmer (1854).

THEOR'BO, a musical instrument of the lute kind, which has long fallen into disuse. Old Mace ("Musick's Monuments," London, 1676) says: "The theorboe is no other than that which we called the old English lute." The distinction between the theorbo and the lute proper was that the former had two sets of tuning pegs, the lowermost being for ten or twelve usual lute strings, the uppermost being for eight or ten bass strings, very large and powerful; hence its name of the bass-lute in Germany (*basslaute*). It is said to be named after its inventor, a Signor Tiorba, about 1600; but some antiquaries doubt this, and hold it to have existed prior to this date. The length of the theorbo was about 3 feet 6 inches. Large ones, called *chitarrone*, with long necks to gain length for the bass strings, sometimes measured as much as 5 feet 4 inches. Specimens both of the ordinary theorbo and of the chitarrone are in the South Kensington Museum.

THE'OREM (Gr. *theorema*) means properly a thing to be looked at or seen; and is used in mathematics to signify any proposition which states its conclusion or makes any affirmation or negation; as distinguished from a problem, which demands or requires a conclusion to be arrived at, without so much as stating whether that conclusion is even possible. Thus, "Required to draw a tangent to a circle at a given point," is a problem; but "If a straight line be drawn at right angles to a diameter from its extremity, that straight line is a tangent to the circle," is a theorem. The problem asks discovery both of method and demonstration; the theorem asks demonstration only.

THERE'SA, ST. See TERESA.

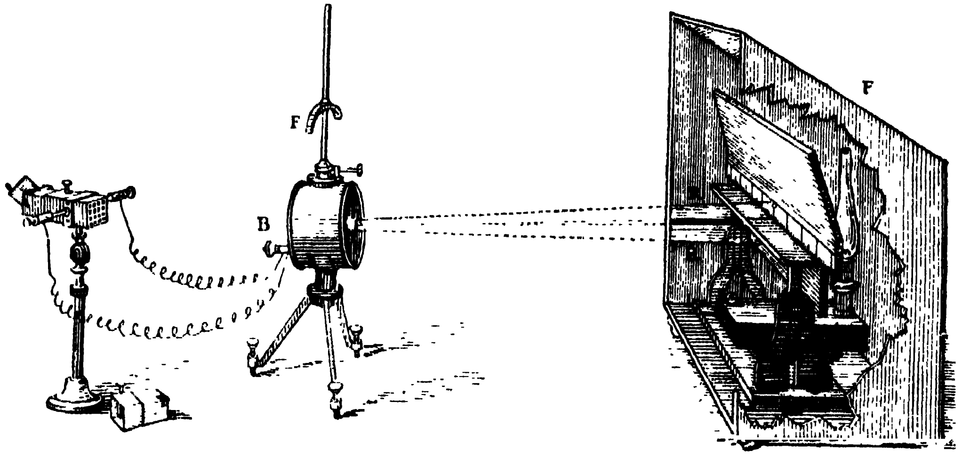
THERE'SIENSTADT (*Maria Theresienstadt*, *Maria Theresianopel*) is a large town in Hungary, 24 miles south-west from Szegedin, in a plain called Teleeska, on the high road to Semlin. In 1743 it was made a free market town, by the name of Szent-Maria, with many privileges; and by the Empress Maria Theresa it was raised to the rank of a free city in January, 1779. It is not properly a town, but rather an assemblage of villages, with a population of 60,000. The chief trade is in agricultural produce.

THER'MÆ, the splendid establishments used by the Romans for the purposes of the BATH. See that article.

THERMIDOR, one of the summer months in the Republican Calendar of the French Revolution. The word means "heat-giver," and the month is the hottest of the year. To convert days in Thermidor into days in July or August, add 18; thus the 10th Thermidor is our 28th July; the 15th Thermidor is our 2nd August. The 10th Thermidor, year 2 (28th July, 1794), is immortalized as the day when Robespierre was executed and the Reign of Terror ended.

THERMO-ELECTRICITY is the term applied to electricity produced in a closed circuit, composed of one or more pairs of dissimilar metals with connecting wire, &c. when the points of contact or junction of the dissimilar metals are heated to a temperature above that of the rest of the circuit.

Take, for example, a bar of bismuth and a bar of antimony, with their inner ends in good contact (by solder or pressure), and their outer ends joined by short thick copper connecting wires to a sensitive galvanometer of low resistance, then upon heating the junction by the flame of a candle or Bunsen burner a current of electricity will flow in the circuit. The strength of this current is proportional to the excess of the temperature at the junction between the bismuth and the antimony above that of their outer extremities. If we cooled the junction (say by applying ice or otherwise), then a current would be generated in the opposite direction to that above mentioned. So long as a constant difference of temperature between the junction and the ends of the two metals is kept up, a constant difference of potential between them will be maintained, thus causing a constant current to flow throughout the circuit.



Heat energy is absorbed at the junction, reappearing as electrical energy in the circuit, and actuating the galvanometer, by which the quantity of electricity may be measured.

Volta's law [see VOLTAIC ELECTRICITY] informs us that if such a combination of metals as we have just illustrated, were joined together, and were kept at one uniform temperature, there would exist a difference of potential at the junction between the bismuth bar and the copper connecting wire, tending to send a current in one direction, but equal and opposite to the sum of the differences of potential between the junction of the bismuth-antimony bars and the antimony bar with the other copper connecting wire; hence perfect equilibrium between these forces would ensue, and no current would be generated. This equilibrium, as we have seen, however, ceases the moment that heat is applied to the junction between the bismuth and antimony. The electro-motive force thus brought into play obeys the following laws:—(1) The thermo-electro-motive force is, for the same pair of metals, proportional (throughout considerable ranges of temperature) to the excess of temperature of the junction over the rest of the circuit. (2) The total thermo-electro-motive force in a circuit is the sum of all the separate thermo-electro-motive forces at the various junctions. The following table, taken from Munro and Jamieson's "Pocket-book of Electrical Rules, Tables, and Formulæ," gives what is called the thermo-electric series or scale.

Thermo-electric Scale.—With respect to lead, at a mean temperature of 20° C. (Matthiessen). The E.M.F.'s are in microvolts per degree centigrade. Small impurities in the metals often cause considerable difference in the E.M.F.

Bismuth of commerce in wire,	+ 97·0
" pure "	+ 89·0
" crystallized along axis,	+ 65·0
" " normal to axis,	+ 45·0
Cobalt,	+ 22·0
German Silver,	+ 11·75
Mercury,	+ 0·418
Lead,	0·
Tin,	— 0·1
Copper of commerce,	— 0·1
Platinum,	— 0·7
Gold,	— 1·2
Antimony, pure, in wire,	— 3·8
Silver,	— 3·0
Zinc,	— 3·7
Copper, galvano-plastic,	— 3·8
Antimony of commerce in wire,	— 6·0
Arsenic,	— 13·56
Iron, piano wire,	— 17·50
Antimony, crystallized along axis,	— 22·60
" " normal to axis,	— 26·40
Phosphorus (red),	— 29·70
Tellurium,	—502·00
Selenium,	—807·00

The above table shows that the heating of the junction of a single pair composed of any of the metals mentioned generates but a very small difference between them; *e.g.*, take bismuth as wire, and antimony crystallized along its axis, and heat their junction by 1° C. we have—

Bismuth, + 97·0
Antimony, — 22·6

Total E.M.F. (subtract)=119·6 microvolts,

and since one microvolt is only the one-millionth part of a volt, it would require 100 such pairs joined together, with all their inner ends heated to 100° C. above their outer ends, to produce 1·196 volt, which is just about the E.M.F. of a single Daniell (copper zinc) voltaic cell.

$$\text{For, } \frac{119{\cdot}6}{1{,}000{,}000} \text{ volt} \times 100 \text{ pairs} \times 100^\circ \text{ C.} = 1{\cdot}196 \text{ volt.}$$

The electro-motive force, or difference of potential, obtainable from any of the other pairs of metals may be similarly calculated from the above table, by simply taking the difference between the numbers opposite each; *e.g.*, take copper and iron.

We see opposite copper – 3·8
And opposite iron – 17·5

Subtracting we get 13·7 microvolts = ·0000187 volt.

Thermo-Electric Piles. Many plans have been devised for joining together numerous pairs of dissimilar metals, so as to obtain the current necessary for working telegraph and other electrical instruments, instead of employing, as at present, voltaic batteries; but hitherto it has been found impossible to keep them in good working order for any reasonable time, and the expense of generating the current by them was equally great, if not more so. In some way or other not very easily explained, a molecular change takes place at the junctions of the dissimilar metals by the continued application of heat combined with the electric currents flowing through them, and this in a comparatively short time renders them useless. Clamond thermo-piles of large dimensions and great current-generating power were carefully tried for some time by Mr. Preece, the chief electrician of the government telegraphs at the Central Post Office, St. Martin's-le-Grand, London, with the view of ascertaining whether they could not be used instead of the ordinary telegraphic batteries, but after a careful and prolonged trial they had to be abandoned. Lord Rayleigh has since then demonstrated that we cannot, from the nature of things, expect to economically generate electricity by such means. Thermo-piles upon a small scale are, however, much used in connection with physical lectures, and are of great use for detecting exceedingly small differences of temperature. Perhaps one of the best ways of employing them is that of joining up a small thermo-pile in direct circuit with a low-resistance sensitive mirror galvanometer (as shown in the figure on the opposite page), when even the approach of the hand near one of the faces of the thermo pile is at once indicated by the deflection of the spot of light to the right or to the left, according as the current flows in the one direction or the other. Since the electro-motive force, and consequently the current generated, are proportional to the difference of temperature between the hotter set of junctions on the one face of the thermo-pile and the cooler set on the other face, and since the deflections of the spot of light are practically proportional to the currents, we may at once read off relative differences of the temperature between the faces of the thermo-pile by simply observing the deflections of the spot on the graduated scale. Therefore, by keeping one face of the thermo-pile at a constant temperature, we may detect much smaller differences of temperature in the other face than could be observed by any ordinary thermometer.

THERMOM'ETER (from Gr. *thermos*, heat, and *metron*, a measure), an instrument for indicating the temperature of bodies, or measuring their relative degrees of heat. Instruments to measure the amount of heat contained by bodies, which is not the same as their hotness (for the same amount of heat will raise some bodies to a greater degree of heat than others), are called calorimeters. [See HEAT, section *Calorimeter.*] Gradations of heat above the range of a mercurial thermometer are measured by the PYROMETER, but it is manifest that in essence the thermometer and pyrometer are the same.

Although nothing deserving the name of thermometer was known until late in the sixteenth century, it appears certain that there existed various contrivances for the measurement of heat in a rough way at a far earlier period, the temperatures of the old Roman baths being sometimes regulated by the softening and melting of wax, oleaginous matters, &c. Pliny hints at something of this kind.

About 1580 the *savans* of Florence and Padua seem to have directed their efforts towards the production of a heat-measurer, and four or five years later, long glass tubes closed at one end, but open at the other, and partly filled with water, spirit, or other fluids, were proposed for use as indicators of heat.

Nothing further appears to have been accomplished in the matter for fully a quarter of a century, at which period a certain Cassoni or Corsoni apparently broached the subject of heat-indicators once more, suggesting the use of a glass tube open at the top, and furnished with a bulb for containing the expansible liquid at the lower end. This arrangement was gradually improved upon by the Florentine academicians, a kind of rough graduation being attempted by means of little projecting studs of enamel or opal glass welded upon the tube at equal distances. It is probable that about this time (1618-23) C. von Drebbel of Alkmaer, who certainly travelled much and visited Italy, first substituted spirit for the water and oil which had previously been used.

Padua next claimed the honour of discovering or improving the thermometer through her representative Sanctorio, who, instead of partly filling the Florentine glasses with a fluid and supporting them bulb downwards, inverted them into vessels of coloured water in such a manner that the latter rose to a small height in the stem, the remainder of which and the bulb at the top contained air. Hence this instrument has been known by the name of the air thermometer.

Up to this point all thermometers had been made open at one end; indeed it was imagined that expansion and contraction could not take place in closed vessels. Our own countryman Boyle first demonstrated the fallacy of this idea. He was greatly interested in the Florentine glasses, or spirit-tubes, and after numerous experiments showed that open-tube thermometers were affected very considerably by atmospheric changes, while tubes hermetically sealed were not liable to error from this source.

In 1700-1 Newton tried several fluids for thermometrical purposes, reverting, as had already been done in Italy, to oil, which was again discarded on account of its adhering to the sides of the tube. Spirit and air thermometers once more divided the field between them, until in 1723 Fahrenheit suggested mercury, as a fluid possessing manifold advantages over oil and spirit, for thermometers. Mercury expands very regularly for equal increments of heat within ordinary ranges of temperature, while its boiling point is comparatively high (being 661·7° Fahr.), and it remains liquid at some seventy odd degrees below that at which water freezes.

Dr. Hooke's discoveries of the fixed temperatures of the freezing and boiling points of water paved the way for the determination of a trustworthy scale of degrees, and very numerous have been the methods proposed. De Lisle's scale made the boiling point of water 0°, and the temperature of its congelation 150°, but this system has never been very largely adopted, and is now almost exploded. Réaumur's scale and that of Celsius (better known as the Centigrade) start from the freezing point as zero, dividing the space between it and that of ebullition into 80 and 100 degrees respectively: the former plan is now gradually passing into disuse, but the Centigrade has long been the favourite on the Continent, and is yearly gaining ground in this country.

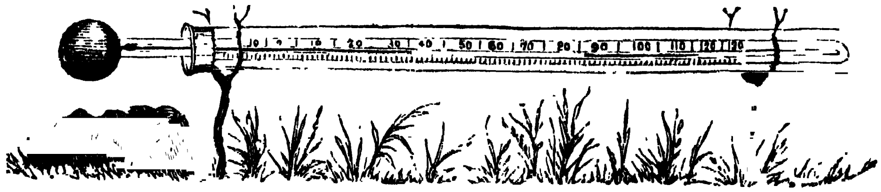
On the whole, however, Fahrenheit's scale has always been preferred in England, and it certainly possesses the advantage not presented by any other, of small degrees, which are far more convenient for general purposes. Under this system the point to which mercury falls when the bulb of the thermometer is plunged into a mixture of powdered ice (or snow) and salt is marked 0°, and forms the zero of the scale. If at this temperature a known cubic volume of mercury is employed, we shall find on removing the instrument to a vessel of melting ice (or, what is the same thing, freezing water) that the mercury will expand, and occupy nearly $\frac{11156}{11124}$ of its original bulk; accordingly ($11156 - 11124 = 32$) the temperature of freezing is marked 32°. At the boiling point of water the mercury will have expanded to the extent of $\frac{180}{11124}$ in addition, and

thus the 212° is arrived at. Several persons, among them Romer, Dr. Halley, and a Sicilian named Vocarini, are reported to have first suggested the use of mercury, but Fahrenheit seems the only one who backed up his idea by making the instrument. Since water freezes at 32° Fahr. and boils at 212° Fahr., the distance between the two points is 180°. As this same distance is 100° C. it follows that 9° Fahr. = 5° C. To convert degrees centigrade into Fahrenheit multiply by 9 and divide by 5 and add 32 to the result.

In our article on Heat many varieties of thermometers are referred to, and among the illustrations are several of air, spirit, and metal.

Registering thermometers, or those which show the highest or lowest temperature, as the case may be, which has occurred during the absence of the observer, were not brought to any degree of perfection until a few years ago; but for all ordinary household or horticultural purposes two forms have long been in use. The construction of Sixe's and of Rutherford's registering thermometers is given in the article Heat.

Professor Phillips' improvement upon Rutherford's

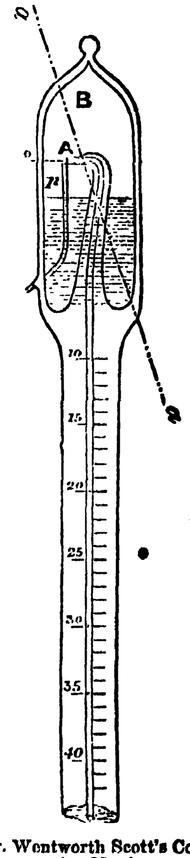


Professor Phillips' Maximum Thermometer in Action on Grass.

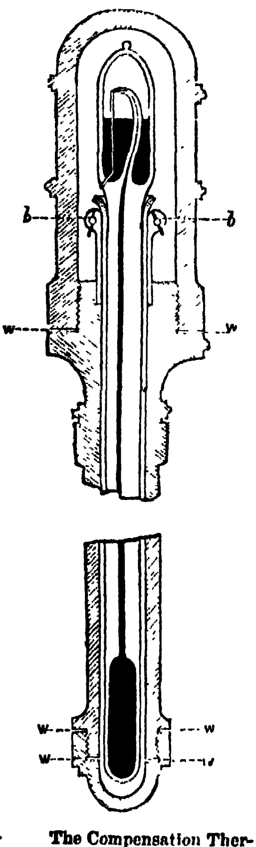
maximum is a most useful form, and its action is seen at once from the annexed figure. A small portion of the mercury itself is separated from the remainder of the column by a minute bubble of air, and so plays the part of Rutherford's steel index; the bore of the tube must be very small. This is the form generally adopted for medical observations, taking the temperature of the mouth or the arm-pit during disease, as in fevers, &c. The instruments for such purposes are very delicate and small, but fairly accurate. The temperature once recorded they may be held in any position without altering it.

For instruments of great accuracy other constructions are needed; and one of the best of these is Mr. Wentworth Scott's Compensation Maximum Thermometer, which gained the Society of Arts silver medal.

This instrument consists of a glass tube, with a cylindrical bulb containing mercury at its lower extremity; at the top the stem is drawn out into a fine jet, bent at right angles (A) in the interior of the second bulb (B); this upper bulb is about half filled with mercury, the remaining space being a vacuum; near its base a platinum wire (p) is welded into the glass, and bent upwards, so that its point is nearly in contact with that of the jet. It is obvious that when the instrument is set, *i.e.*, the lower bulb and capillary tube completely filled to the point of the jet with mercury, any rise of temperature will expand the mercury and cause it to overflow in minute globules into the reservoir above. The platinum wire is simply for the purpose of preventing the formation of large drops at the point of the jet, by its superior attraction for the fluid metal. Upon cooling, the mercury now remaining will, of course, sink in the tube. The instrument is so graduated that if it were cooled to 0° Fahr., the level of the mercury would precisely indicate the highest temperature to which it had been previously exposed; but if the observation were made at the atmospheric temperature, the mercury would stand exactly as much higher in the tube, *i.e.*, lower on the scale, as the temperature of the air was above 0° Fahr.; therefore, to ascertain the maximum temperature, it is only necessary to add to the degree at which the mercury stands the temperature at the time the observation is made. Thus, supposing the compensation thermometer marks 35°, and an ordinary instrument by its side is at 50° (35° + 50° =) 85° will be the highest temperature that has occurred since the last observation. To set this thermometer, the lower bulb must be gently raised, until the mercury runs down the tube into the reservoir-bulb; when contact has thus been established between the two portions of the metal, the reservoir-bulb is slightly elevated, care being taken to keep the point of the glass jet under the surface of the fluid metal (the dotted line, *a a*, in the diagram represents the level of the mercury during this operation). The mercury will now flow back into the lower bulb, and refill the small



Mr. Wentworth Scott's Compensation Maximum Thermometer.



The Compensation Thermometer—Deep-sea Arrangement.

vacuum produced by the previous decantation, when, upon restoring the instrument to its vertical position, the tube will be full to the extreme point of the jet. It will be at

once seen that vibration or agitation cannot affect the accuracy of this instrument, no movable indices whatever being employed. We give a view of the upper bulb, and a portion of the scale, and also sections of the instrument in a gun-metal tube, as arranged for deep-sea experiments. The thermometer is set and inserted in the tube, oscillation being prevented by rings of vulcanized india-rubber, the upper one clamped by the binding screws (*b b*). Well greased leather washers occupy the spaces (*w w*). From the peculiarity of its construction, the registrations of this thermometer must be accurate. Some examples register to the thousandth of a degree Fahr.

By introducing a platinum wire into the lower as well as the upper bulb, and connecting both with a voltaic arrangement, a *telegraphic thermometer* is constructed, which may form a tell-tale for boiler-pressure, a fire alarum, a hothouse indicator, &c. Professor Wheatstone introduced a telegraphic thermometer to the British Association at Dundee, in 1867. This thermometer is a metallic one upon Breguet's principle, the indicator of which communicates by means of insulated wires with a magneto-motor, and enables observations of the temperature at the summit of a mountain or the bottom of the sea to be transmitted any number of miles.

The great thermometric desideratum of the present day is a good, uniform, international scale of degrees. The determination of the exact freezing-point of mercury will be a first step towards the latter result; Balfour Stewart and Wentworth Scott give −37·930 Fahr. and −37·885 Fahr. respectively. See also HEAT, BOILING OF LIQUIDS, PYROMETER, &c.

THERMOPILE. See the article HEAT, which contains an illustration of the instrument.

THERMOP'YLÆ (Greek *Thermopulai*, *i.e.* the hot gates), a celebrated pass in Greece, opening from Thessaly upon Lokris, and forming a single road by which an hostile army can defile through the mountains into Southern Greece. On one side lies an impassable morass, on the other rises Mount Œta, and the pass itself consists—or rather *did* consist, for the diversion of the course of the river Spercheius has greatly changed the face of the country—of two openings, each so narrow as scarcely to leave room for a single carriage, and separated by a wider space of about half a mile in length. The eastern opening is the true Thermopylæ, and the scene of the famous stand made by Leonidas, and a small force of 10,000 men, against the Persian hosts under Xerxes (480 B.C.) Leonidas had with him 300 Spartans, 2120 Arkadians, 400 Corinthians, 200 men from Philos, 80 from Mukenai, 1000 Phokians, about 3000 Lokrians, besides Helots and other light troops. Their resistance against the Persian legions was marked by the highest courage; but unfortunately a pass existed over Mount Œta, unknown to Leonidas, which a traitor revealed to Xerxes, and the Persians were able to attack the Greeks in the rear. Hemmed in between two masses of men, nothing remained for Leonidas but to sell his life dearly. He sent away, however, the allies, and withstood the shock with his 300 Spartans, 400 Thebans, and a body of Thespeian troops. The Spartans were slain to the last man, but not before they had gloriously avenged themselves on their enemies. The battle lasted from noon till night. The Thebans, when they found further resistance useless, surrendered to Xerxes.

Thermopylæ, in 279 B.C. was the scene of a somewhat similar but less glorious struggle between the Gauls, under Brennus, and an army of Greeks, who were again betrayed and forced to retreat. Here also, in 191 B.C., Antiochos the Great, of Syria, was defeated by the Romans.

THERSI'TES has earned an unenviable immortality by his foul appearance and fouler scurrility, so that he has passed into a proverb. He was among the forces of the Greeks at Troy, and though his impudence brought him many a beating, a certain cynical courage sustained him. His portraiture represents the nearest approach to comedy indulged in by Homer. In the end, according to a later poet, he ventured to ridicule Achilles, who was lamenting the death of the heroic Penthesileia, queen of the Amazons, when he had slain her in battle, and the angry hero turned upon him with such fury that Thersites perished of his wounds.

THE'SEUS, the great national hero of Athens, is said to have been born at Troizên. His father was Aigeus, king of Athens, and his mother Aithra, the daughter of Pittheus, king of Troizên. Arrived at maturity he took his father's sword and sandals, left with Aithra as tokens of remembrance, and fared to Athens, ridding the country of the monsters Prokrustês, Sinis, Kerkuôn (who wrestled to the death with all strangers) and many others, by the way. Aigeus recognized him, and in the end acknowledged him as his son and successor. Thêseus next destroyed the wild bull of Marathon, long a terror to the country, and in all things seems to have set Hêraklês before him as his model. The time came for the yearly tribute of seven youths and seven maidens to be sent to feed the monster Minotauros in Crete. Thêseus volunteered to be one of the fated crew, and the princess Ariadnê falling in love with him, gave him the clue to the labyrinth wherein the monster was confined, and a sword wherewith to slay him. This deed performed she eloped with her lover, sailing to the island of Naxos. Here Thêseus after a time abandoned her; but she was found by the god Dionusos, who protected her. It had been agreed with Aigeus that Thêseus was to change the dark sail of the ship for a white one if he returned successful. This he forgot to do, and Aigeus sighting his ship as it neared Athens, was led to think his son was lost, whereupon he threw himself into the sea and perished. Thêseus thereafter ruled at Athens.

He is represented as the founder of the Attic commonwealth, and even of its democratical institutions. Before his time Attica, it is said, contained many independent townships, which were only nominally united. Thêseus incorporated the people into one state, removed the principal courts of the administration of justice to Athens, and greatly enlarged the city. To cement their union he instituted several festivals, and changed the Athenaia into the Panathenaia, or the festival of the Atticans. He also founded the Isthmian games, defeated the Amazons, and captured their queen, Antiopê, by whom he had a son, Hippolutos. On the death of Antiopê (whom Shakespeare, following some of the poets, calls Hippolyta, in the "Midsummer Night's Dream") Thêseus married the young and beautiful Phaidra, and the fatal effect of a passion the unhappy princess conceived for her stepson Hippolutos is the subject of one of the most famous of the plays of Euripides.

Thêseus took part in a large number of the great heroic expeditions. He was one of the Argonauts, he took part with Meleagros in the boar-hunt of Kaludôn, he rescued for burial the bodies of the "Seven against Thebes" (or rather of the six who had fallen, at the prayer of the Seventh), he fought with his friend Peirithoös against the Kentaurs, carried off Helen (then a girl) with his help, and in return assisted him to carry off Persephonê, goddess of the under world. But this last, successful as Thêseus had always been, was a task too great even for him. Peirithoös perished outright, Thêseus was made prisoner in Hades. Fortunately for him, Hêraklês descended thither and was magnanimous enough to release his brother-hero and friend. He returned to Athens to find both Helen and her guardian, his mother Aithra, carried off by the twin demigods Kastôr and Poludeukês (Castor and Pollux), Helen's brothers, and the city completely in revolt against his authority. He retired in great grief to Skuros (the modern island of Scyro), where Lykomêdes treacherously slew him. His shade appeared to help the Athenians at Marathon B.C. 490; in

gratitude for this Kimon searched out his bones in Skuros in B.C. 469 and brought them to Athens, where they were deposited in a temple (the Thêseion) erected in their honour, and a festival was observed every month in memory of the hero. The Thêseion (Lat. *Theseum*) is engraved in the Plate illustrating the article ARCHITECTURE.

THE'SIS. See ARSIS.

THESMOPHO'RIA, the great three-days women's festival, held in October at Athens, in honour of the goddess Dêmêtêr the "law-bearer," in which women carried (*pherô*) the sacred traditional law-books (*thesmoi*) on their heads, and celebrated the mysteries of Dêmêtêr at Eleusis.

THESPEI'AI (Lat. *Thespiæ*), an ancient sea-coast town near Mount Helikon, memorable among other things for having been almost the only Bœotian town which refused to surrender to Xerxes, and which sent a contingent to Thermopylæ to defend that pass with the brave Leonidas. In revenge Xerxes burned it to the ground; but it was afterwards rebuilt.

THES'PIS, the father of the Greek drama, was a native of Attica in the time when Peisistratos was tyrant of Athens. The worship of Dionusos by choral odes, celebrating the deeds of the god, and also of other gods, was of old date. Thespis improved it by introducing a reciter, who narrated the chosen episodes with far more spirit than the chorus could do. From this he passed to the idea of representing successively several personages in the legend, each with his or her appropriate dress and mask. The waggon in which Thespis is said to have travelled from place to place, using it as a stage whereon to enact his dramas, is now held to be mythical. The Thespian drama was, as has been shown, a series of monologues and occasional dialogues with the chorus, divided by choral odes. The subsequent passage to the simultaneous appearance of two actors (an improvement of Aischulos), and finally to that of three (due to Sophokles, and always remaining the most allowed in Greek drama), was of course quite easy. The date B.C. 535 is given as that of Thespis' first complete dramatic representation.

THESSALO'NIANS, EPISTLES TO THE. The first of these, written by the apostle Paul to the society of Christians in Thessalonica, is the earliest of his writings extant, and is probably the earliest of the written records of Christianity. The apostle had preached in the city of Thessalonica during his second missionary journey, and in spite of the active opposition of the Jews had established a church there composed of converts gained from the Jews, proselytes, and the pagan inhabitants of the city. Driven from the city by persecution he afterwards twice attempted to revisit it, but being prevented from doing so he sent Timothy to inquire as to the welfare of the church and to bring him word again. On being joined at Corinth by his messenger, who brought most favourable tidings b[illegible] as to the progress of the new converts in Christian faith and practice, and their attachment to the apostle himself, he writes to express his gratitude and joy, and also to convey to them some instruction and warning which had become necessary. The body of the epistle may be divided into two parts: the first, extending over the first three chapters, being of a narrative and personal character; and the second, comprising the fourth and fifth chapters, being of a hortatory character, containing exhortations to purity and holiness and instruction concerning the second coming of the Lord—each portion concluding with a prayer for the Thessalonians. The date of the epistle is usually assigned to the years 52–53 of the received chronology, and it is noteworthy that at this early period the point brought most prominently forward in Christian doctrine is that of the second coming of the Lord, which was then thought to be near at hand. There is no mention of the controversy as to faith and works, nor of justification, and the idea of dying with Christ and living with Christ, afterwards brought so prominently forward by the apostle, is not here referred to. The epistle was unanimously accepted as genuine by the early church, and from the time of Irenæus downwards it has been quoted and referred to as the work of the apostle Paul, and it was left to Schrader, writing in the present century, to be the first to impugn its genuineness. He was followed by Baur and some other members of the same school of criticism, but the arguments of these critics have met with but little favour among modern scholars so far as this epistle is concerned, and the labours of Jowett, Ellicott, and other writers have shown that the internal evidence in favour of its genuineness is almost irresistible. The Second Epistle to the Thessalonians was written apparently a few months after the first, its object being to correct some mistaken notions of the believers concerning the second advent, and to guard them against some attempts that were made to mislead them by means of forged letters purporting to come from himself. Like the first epistle it was always received as genuine until the present century, but it has since been assailed chiefly on account of the obscure apocalyptic passage contained in the first twelve verses of the second chapter, which has always been a difficulty to commentators, and in which some modern critics find references to events of a period much later than that in which the epistle purports to be written. Apart from this confessedly obscure passage the internal evidence of the epistle is strongly in favour of its Pauline origin.

THESSALONI'CA. See SALONICA.

THES'SALY (Gr. *Thessalia*), one of the principal divisions of ancient northern Greece, and restored by Turkey to modern Greece since the treaty of Berlin in 1878, is an extensive and generally unbroken plain, about 80 miles in extreme length and 70 in breadth, comprising an area of about 5500 square miles, and forming an irregular sort of square.

It is entirely surrounded by mountains, broken at the north-east corner only by the valley and defile of TEMPE (or "the Cut"), which separates Mount Ossa from Olympus, and presents the only road from Thessaly to the north which does not lead over a mountain pass. The boundaries of the province are—on the W., the range of Pindus, separating it from Epirus and Albania; on the N. the Cambunian Mountains, dividing it from Macedonia; on the S., the chain of Mount Othrys; and on the E., a range of heights which run along the coast, nearly parallel to the Pindus, and include Mounts Kissova and Zagora, the ancient PELION and OSSA.

According to Greek traditions Thessaly was known in remote times by the names of Pyrrha, Æmonia, and Æolis. The chief cities were Pharsalus, Larissa, Heracleum, and Pheræ, and for a long period the principal power was in the hands of the two great families of Aleuads and Scopads, famous for their hospitality and encouragement of poets and artists.

The plains of Thessaly, with the exception of those of Bœotia, were among the most fertile and productive of Greece in wine, oil, and grain, but more especially the latter, of which a cosiderable quantity was exported. The Thessalians thus became very rich and luxurious in their mode of life. Thessaly was also famous for its cavalry, which were considered the best in Greece; its plains supplied abundance of forage for horses, and the breed was, and is still, very fine. The principal products of the country at present are grain, cotton, olives, and silk.

LARISSA is the present chief town of Thessaly. In the province of Larissa are the remarkable monasteries at Meteora, which occupy a high-lying valley on the eastern slope of the range of Pindus. Here a number of isolated rocks occur, which have a character perfectly unique to the eye. as if formed by the art of man rather than by the more

varied and irregular operations of nature. Some are quite conical in shape; others are single pillars of great height and very small diameter; others are nearly rhomboidal, and actually incline over their base; not a few are perfect oblongs, with perpendicular sides and level summits. They rise from the midst of splendid vegetation, which also partly fills up the intervals between them. Their elevation varies from 200 to 300 feet. It is on the tops of these pinnacles and towers, which seem unapproachable by the foot of man, that the religious houses are placed; and in some instances they so entirely cover them that the precipices descend from every side of the buildings into the deep-wooded hollows below.

THET'FORD, a small town of England, in the counties of Norfolk and Suffolk, 95½ miles from London by rail, situated on both sides of the Little Ouse, here joined on the east by the Thet, 28 miles W.S.W. of Norwich. It is irregularly built, and contains several churches and chapels, an ancient guild hall, grammar school, and mechanics institute. It has a large manufactory of agricultural implements, breweries, paper and bone mills; malting and tanning are carried on. The town is governed by four aldermen and twelve councillors, including the mayor. The population in 1881 was 4032.

Thetford is generally supposed to occupy the site of the *Sitomagus* of the Romans. During the Heptarchy it was the capital of the East Anglian kingdom, and on the east side of the town are remains of intrenchments supposed to date from that period. In the time of Canute a convent was founded in the town, some remains of which are still extant. The gateway of a priory, founded in 1104, and some traces of a monastery established at a later period, may also be seen. In the reign of Edward III. it is said to have had twenty-four principal streets, five market-places, twenty churches, eight monasteries, and six hospitals, besides other public foundations; but these statements are of doubtful authenticity, and are probably much exaggerated. It has been occasionally visited in more modern times by some of the British sovereigns, particularly James I., who had a hunting-seat in the neighbourhood. The town was incorporated in 1573, and returned two members to Parliament from the time of Edward VI. to 1867.

THE'TIS, in Greek mythology, one of the Nereids, and wife of Pêleus, king of Thessaly, by whom she became the mother of Achilles. Like Proteus, she possessed the power of metamorphosis. It was at her marriage with Pêleus that Eris, or Discord, flung on the table the golden apple as the prize of the most beautiful, for which Hera, Aphroditê, and Athena afterwards contended before Paris.

THI'ALDINE, an organic base containing sulphur, which is obtained by acting on aldehydrate of ammonia with sulphydric acid. It is obtained in large strongly refracting crystals, which melt at 43° C. (113° Fahr.), and volatilize in the air. It is insoluble in water, but very soluble in alcohol and ether. The formula is $C_6H_{13}NS_2$. It combines with acids, forming crystalline soluble salts. The nitrate has the formula $C_6H_{13}NS_2HNO_3$.

THIAN-SHAN or **CELESTIAL MOUNTAINS,** a lofty range in Central Asia, extending between 65° and 95° E. lon. for a distance of about 1500 miles, in 42° N. mean lat. The central summit of Tengri Khan (about 20,100 feet) divides the range into the Western Thian Shan, extending across the north side of the Pamir plateau, toward Samarcand and Bokhara, and the Eastern Thian Shan, reaching along the north side of the basin of Eastern Turkistan to Hami and Barkul in Mongolia. The Altai are but an advanced buttress of this great chain, which forms the true north boundary of the Central Asiatic table-land. Most of its summits pass far above the snow-line, and several considerably exceed 20,000 feet; but the range is crossed by a number of difficult passes between Kokan, Vernoie, or Kulja, and Kashgar in the west, and between Urumtsi and Turfan, Hami and Barkul (an easy route) in the east.

THIBAUT OF CHAMPAGNE, King of Navarre (1201–53), is the most important figure of early French lyrical poetry. He is said to have been the lover, and was certainly the tenderly-attached friend, of Queen Blanche of Castile, mother of St. Louis, but the queen-mother was thirty years his senior. The poems of Thibaut are remarkable and interesting, as from his lordship of Champagne he was acquainted with northern idioms and the freshness and vigour of the Trouvères, while his rule of Navarre brought him among the Provençal poets and gave him the formal elegance of the Troubadours. A pretty little song of Thibaut's (Englished rather clumsily as "T'other morning very early") is a favourite with glee singers, who use it arranged as a vocal quartet. There seems no reason to doubt the authenticity of the melody, though the usual modern harmonic dress rather alters its original effect.

THICK-KNEE. See STONE CURLEW.

THIERRY, AMEDÉE and **AUGUSTIN,** are two distinguished French historical writers of the present century. Amedée (1787–1873) devoted himself to the history of Gaul in Roman times and Roman history. Jacques Nicolas Augustin, by far the more gifted of the brothers (1795–1856), began by being a disciple of St. Simon and a fellow-worker of Comte (1814–17). Then taking to historical studies he wrote an excellent "History of the Norman Conquest of England," in 1825. In 1835, though then blind, he published his "Ten Years of Historical Studies," and in 1840 his "History of the Merovingian Period," not only his best work, but one of the best works of the kind in the century, fascinating in style, and as picturesque as it is accurate. In 1853 he brought out a "History of the Tiers Etat."

THIERS, LOUIS ADOLPHE, an eminent French writer and statesman, was the son of a working locksmith at Marseilles, and was born on 16th April, 1797. As a boy he displayed great intelligence, making rapid progress at school, where he studied geometry with a view to joining the military profession; but his friends afterwards determining that he should study law, he became a pupil of M. Arnaud at Aix. Meeting with no success at the bar, he determined to go to Paris and enter the ranks of literature. In the capital he became acquainted with the leading men of letters, and distinguished himself as a contributor to the *Constitutionnel*. The greater part of his time, however, for nine years, was devoted to his "History of the French Revolution," the first volume of which appeared in 1823, and the last in 1832. After the revolution of July, 1830, he held various minor official posts, and under Laffitte's administration became under-secretary of state. He was elected deputy for Aix, and earned a reputation for financial ability, oratorical power, and capacity for hard work. Two years after the revolution we find him minister of the interior; he also held for some time the portfolios of commerce and public works. Every office seemed one in which he found an opportunity of gaining distinction; and in 1836 he became president of the council and minister of foreign affairs, an office he again held in March, 1840. During this ministry he was held responsible for the serious aspect which the Syrian question assumed, France being nearly involved in war with England through his policy. He was therefore called upon by the king to retire from official life. M. Thiers accordingly disappeared for a time from the political world, but used the leisure of his retirement by commencing his "History of the Consulate and Empire." It was his chief literary work, comprising twenty volumes, the first of which appeared in 1845, and the last in 1862. During

this time, it is scarcely necessary to say, there had been some exciting episodes in the history of France. In 1848 the French Revolution shook the country to its base. When the republic was proclaimed Thiers was found in the uniform and bearing the musket of a National Guard; he presently figured as a member of the Constituent and of the National Assemblies. When Louis Napoleon was proclaimed president, M. Thiers declined to take office. He was banished during the *coup d'état* of December, 1851, when he went to Switzerland, and remained there for some time studying painting and the fine arts. In 1863 he again interested himself in the political affairs of his own country. He was elected deputy for the department of the Seine by the Liberal opposition. Taking advantage of every opportunity that presented itself for attacking the administration of the finances, the municipal control of Paris by Baron Haussmann, and the foreign policy of the emperor, M. Thiers was soon a power in himself. After 1866 he sarcastically taunted the government with the loss of its prestige. When, however, war was inevitable in 1870, he earnestly protested against it, and warned the government that it was rushing headlong to destruction. But his warning came too late. War was proclaimed, and France soon met with reverses which brought M. Thiers to the front in a most remarkable manner. He delivered a speech in the Corps Législatif, in which he called upon Paris to offer an invincible resistance to the enemy. He was appointed a member of the Paris Defence Committee, but declined to share the responsibility of the national defence on the downfall of the empire. Still he continued to do what he could for his unhappy country, and visited the courts of England, Russia, Austria, and Italy to implore aid for France. In this mission, however, he was unsuccessful; and in October, 1870, he returned to Tours, whence he proceeded to the headquarters of the King of Prussia at Versailles, to open negotiations for peace, in accordance with the suggestion of the four neutral powers. He had several interviews with Count Bismarck, in order to obtain an armistice of twenty-five days, so as to enable elections to be held throughout the country, and a national government to be thus regularly established. But the German chancellor would not allow Paris to be revictualled during the interval, and these negotiations also fell through. M. Thiers then returned to Tours, and placed his services at the disposal of the delegate government. After the capitulation of Paris the country recognized his services in trying to restore peace, by electing him to the National Assembly by the voice of one-third of the nation; and he was, in February, 1871, elected the head of the Provisional Government, with the privilege of taking part in the deliberations of the Assembly whenever he pleased. The value of this privilege was especially observable when the government held its sittings at Bordeaux, as M. Thiers was then able to ta part in the debates. Soon after his election as chief of the executive power, he introduced the preliminaries of the treaty of peace to the Assembly, and after an animated debate of two days' duration they were voted by 546 ayes against 107 noes. By this treaty France renounced, in favour of the German Empire, the fifth part of Lorraine, including Metz and Thionville, and Alsace without Belfort; while she had to pay to Germany five milliards of francs (£200,000,000 sterling), in instalments ranging over three years. It was stipulated that as soon as the treaty was ratified, the German troops should begin to evacuate the interior of Paris and some departments of the western region, other departments to be rendered free from the presence of the German soldiers as the money was gradually paid. On 18th March, 1871, however, soon after the National Assembly moved to Versailles, Paris fell into the hands of the Communists, one of whose acts was to destroy M. Thiers' house. It was not until 22nd May that Marshal MacMahon's army recovered possession of the capital. When order had been in some degree restored the supplementary elections were held, and in July M. Thiers, by a large majority of the Assembly, was voted a prolongation of his office, and his designation was changed from "Chief of the Executive Power" to that of "President of the French Republic." The energetic president devoted all his energies to raising the money to pay the war indemnity, and to the reorganization of the French army; but in consequence of a hostile vote in the Assembly on 24th May, 1873, he resigned, and was succeeded by Marshal MacMahon, who proceeded to form a Conservative administration, his appointment being made for a term of seven years. M. Thiers resumed his place as a member of the National Assembly. His intellect was as clear as ever to the last moment of his busy career, and he had been out walking on the day of his death, which took place from apoplexy at St. Germain, on 2nd September, 1877.

THIN FILMS, COLOURS OF, and of thin plates also, see the articles NEWTON'S RINGS, COLOURS OF THIN FILMS, and INTERFERENCE OF WAVES.

THING'MEN. See HOUSE-CARLS.

THINKING is that operation of the Intellect which is neither Sensation, Perception, Memory, nor Imagination: it is, in fact, general or abstract Knowing. Thinking is divisible into Conception, or the formation of concepts or general notions out of percepts and images; Judgment, or the combination of concepts; and Reasoning, or the combination of judgments. Thus we may form a concept, abstract idea, or notion of a metal, made up of acquaintance with many metals; and we may form a judgment relative to metals, as, for instance, that they are useful to man. We can now pass to the highest order of thinking and reason upon this judgment; we can say "gold is a metal, therefore it is useful to man."

In one sense imagination is opposed to abstract thinking; for the force of imagination lies in its grasp of details, whereas the power of abstraction aims at simple generalizations. Yet the highest abstract thinking is largely assisted by imagination if the latter be kept well under control. Nothing is more remarkable than the way in which the "scientific imagination," as it has been called, has illuminated the more abstruse dicta of science in our own days. Images stored in the memory, accurate in themselves, are combined by the imagination into pictures never yet seen, but which can be tested when they have been thought out. This is the mighty power of hypothesis, valuable only when based upon sure facts and verifiable by experiment.

Pushed to its ultimate analysis, as has been said in the article INTELLECT, thought is composed of the faculty of perceiving agreement, or similarity in diversity, difference or diversity in similarity, and of memory or retentiveness, which permits the past to be compared with the present. Therefore it is in intimate connection with language. There are not wanting philosophers of eminence who declare that thinking is impossible without language, and that brutes cannot think because they cannot talk, nor can children think beyond their powers of expression. Without going to this length every one must admit that advance in language carries with it advance in thought. The thinking races are the races of choice literature, the thinking man is the man of large or of precise vocabulary. Sir William Hamilton hit the truth very happily ("Lectures on Logic," viii.) when he said, "Language is to the mind precisely what the arch is to the tunnel. The power of thinking and the power of excavation are not dependent upon the word in one case, on the mason-work in the other; but without these subsidiaries neither process could be carried on beyond its rudimentary commencement." The extraordinary rapidity with which our youths attain

to powers of thinking, formerly known only to the greatest sages, is due partly to the inherited intellectual power which has grown with the growth of the race, but greatly also to the enormous increase of abstract terms and nice distinctions of language, which suggest and induce processes of thought that the ancient thinker had with infinite pains to discover for himself.

THIONU'RIC ACID or **ALLOXA'NO-SULPHUROUS ACID** is an acid formed by the action of ammonia and sulphurous acid on alloxan. It crystallizes in needles, soluble in water, and having the formula $C_4H_5N_3SO_6$. On boiling the solution it is decomposed into dialuramide ($C_4H_5N_3O_3$) and sulphuric acid. It is a dibasic acid, forming neutral and acid salts called thionurates, which are mostly crystalline. The neutral ammonium salt, which crystallizes in four-sided tables, has the formula $C_4H_3(NH_4)_2N_3SO_6H_2O$. The acid ammonium thionurate crystallizes in needles, which have the formula $C_4H_4(NH_4)N_3SO_6$.

THI'ONVILLE (in German *Diedenhofen*), a fortified town of Germany, in the province of Alsace-Lorraine, situated in a flat country on the Moselle, 15 miles north of Metz. The population is 7500. It surrendered to the German army in November, 1870, after a siege of two days.

THIOSIN'AMINE or **ALLYL-SULPHO-CARBAMIDE** is a compound obtained by acting on volatile oil of mustard with strong ammonia; the mixture, when allowed to stand for some time, solidifies into a crystalline mass. It crystallizes in colourless shining prisms, soluble in hot water, in alcohol, and in ether. The formula is $C_4H_8N_2S$. It melts at 72° C. (162° Fahr.) into a colourless liquid, but it decomposes on further heating. It forms a crystalline salt with hydrochloric acid, having the formula $C_4H_8N_2SHCl$; and also a chloro-platinate, the formula of which is $2(C_4H_8N_2SHCl)PtCl_4$.

THIRD, in music. See INTERVAL.

THIRD FLUTE is an orchestral variety of the usual instrument, a minor Third higher than the concert flute (whence its name), but fingered and blown in the same manner. The fingering and blowing for the note C give the note E♭, and the player produces all sounds, in fact, a minor Third above what he is appearing to play and what is written down in his music. The expression "flute in E♭" is often used for the third-flute, and with advantage; for if a composer writes for three flutes, meaning three concert flutes, and distinguishes them, as he must do, as "first, second, and third," confusion might arise for a moment, until the music were examined. If the flute in E♭ were the "third-flute" desired, its signature would of course be different from the other flutes, being the signature of a key a minor Third lower than theirs. The use of the third flute is to play in keys which are practically impossible on the ordinary flute, say F♯, for example. In the first movement of Spohr's great symphony "Die Weihe der Töne" a third-flute is used, to the great convenience of the performer.

THIRD GUINEA, a seven-shilling piece formerly coined in England, and long since disused.

THIRLEMERE or **LEATHES' WATER**, a beautiful lake of England, in the county of Cumberland, 3½ miles south-east of Keswick; length, 2½ miles; greatest breadth, a quarter of a mile. At one point it is so narrow as to be spanned by a short bridge; height above the sea, 473 feet. It discharges north by a tributary of the Derwent.

THIRL'WALL, CONNOP, Bishop of St. David's, was born at Stepney, London, in 1797, and was one of those rare cases in which the precocious child grows up into the man of strong clear brain, who retains his faculties unclouded and vigorous into a ripe old age. At Cambridge he became Craven scholar and Bell's scholar in 1815, and senior chancellor's medallist in 1818; and after obtaining a fellowship at Trinity College, was called to the bar in 1825. In 1827, in conjunction with his friend J. C. Hare, he translated Niebuhr's "History of Rome." The church, however, enticed him from the study of the law, and he was ordained in 1828, and soon afterwards preferred to the living of Kirby Underdale in Yorkshire. In 1835–37 there appeared his "History of Greece," the literary work on which his claim to the remembrance of posterity mainly rests. Grote's great work on the same subject, which appeared about ten years later, and the great merits of which Bishop Thirlwall was among the first to recognize, has thrown the work of the latter unduly into the shade. In 1840 Lord Melbourne appointed Dr. Thirlwall to the see of St. David's, and in subsequent years he wrote little except on religious subjects. The depth and thoroughness of his knowledge of Hebrew peculiarly qualified him for taking a leading part in the Revision of the Old Testament, and it was while thus engaged that his sight finally failed and the paralysis occurred which compelled him to retire from his episcopal duties, in 1874. He died at Bath the next year, 27th July, 1875.

Canon Perowne published the "Remains of Thirwall," in two vols. of charges and one of essays, speeches, and sermons in 1875, and in 1881 he followed this by the publication of the bishop's "Letters" (two vols.), intensely interesting, valuable, and characteristic.

THIRSK, a market-town of England, in the county of and 23 miles north-west by north from York by the North-eastern Railway, and 210 miles from London, stands on a small stream in a fertile vale. It is a picturesquely situated town, with a large agricultural market, good inns, old houses, and a pleasant neighbourhood. There are no remains of the ancient castle of the Mowbrays; but the church, a splendid Perpendicular structure, claims the attention of the archæologist. Its roof, of Irish oak, is enriched by superb carving. The tower is lofty and massive. There are three sedilia, and also some good stained glass. The population in 1881 was 3337. Thirsk returned two members to Parliament from the time of Edward VI. to 1832, and one from 1832 to 1885, when its representation was merged in that of the county.

THIRST is the peculiar sensation which excites the desire to drink.

The times and degrees in which it is felt during health are in general such that, by satisfying it, the body is provided with the quantity of water necessary for the repair of its tissues and the maintenance of their proper moisture, and for the replacement of the fluid which is constantly lost by perspiration and other discharges. The amount necessary for this purpose varies greatly, according to the different circumstances of age, sex, and temperament, and still more according to the nature of the food taken, the state of the atmosphere, the mode of life, and the customs of the individual.

As a general rule, the degrees of thirst during health is directly proportioned to the rapidity of the exhalation of fluid from the skin and lungs. Hence the naturally greater thirst in summer, and the desire for the fresh fruits of the season, which both supply water and produce moisture of the mouth by exciting a flow of saliva; hence also the less natural thirst which is produced by remaining in hot and crowded rooms, and that which is so painfully felt by those who work about iron-forges and steam-engines, and which they can satisfy only by frequent and enormous draughts of liquids. Of the same kind is the thirst which many have felt in ascending high mountains, on which, as the atmospheric pressure diminishes, the evaporation from the skin is increased; and that which is produced by exposure to a dry brisk wind.

Thirst is felt in the mouth and throat, but in reality exists in the blood. Washing out the mouth is only a temporary alleviation of the appetite; it is necessary to

swallow liquid to satisfy it, or to absorb liquid by the skin, as patients do who bathe in milk when the stomach rejects all food and drink, or sailors who bathe or dip their clothes in the sea when fresh water is running short. Not only the abstraction of moisture, but the addition of saline and other solids to the blood, produces thirst. Thirst is a far fiercer appetite than hunger, and unlike hunger it is always painful. In severe thirst lukewarm fluid is better to take than quite cold, because it avoids stimulating a flow of blood to the stomach and a corresponding increase of pain. Men dying of thirst have borne witness to the increased torture produced by unlimited drinking of cold water. Men can exist many weeks without food, and quite recently several fasting men have performed prodigies in this way for the sake of money, but no man can exist for more than about three days in a dry atmosphere without liquid food. Fever sets in, and the sufferer dies in a dreadful raving delirium, haunted by visions of shade and streams which he cannot reach.

THIRTEENTH, in music. See INTERVAL. For chords of the Thirteenth see DISCORDS, FUNDAMENTAL.

THIRTY TYRANTS, a term applied to the Athenian governors who had been imposed upon Athens by its Spartan conquerors, at the close of the Peloponnesian War, and who were expelled by Thrasuboulos in 404 B.C. In Roman history the same title is bestowed upon a knot of aspirants to the imperial throne of Rome, who from 253 to 268 convulsed the whole empire with their internal feuds. Gibbon is unable to identify more than nineteen, however. The best among them was Odenathus, who maintained himself at Palmyra, received the title of Augustus from the Roman senate, and was enabled to bequeath his empire to his widow, the celebrated Zenobia.

THIRTY YEARS' WAR is the name of that memorable contest which lasted from 1618 to 1648, between the Emperor and the Roman Catholic states of Germany on one side, and the Protestant states, with their allies, Denmark, and afterwards Sweden and France, on the other. This long struggle has generally been considered a religious war, but political objects were very real motives of the contending parties, and religion was often only used to veil the designs of the leaders.

Towards the end of the sixteenth century the Roman Catholic party recovered the political influence which it had been losing since the treaty of Passau (1552); and in May, 1608, the "Protestant Union" was established for the purpose of resisting the Catholic demand for the restitution of all the territories which had been seized by the Protestants. The Elector-Palatine Frederick IV., a Calvinist, was its leader.

The formation of the Roman Catholic Liga or League, in 1609, was the immediate reply, and the confusion caused by the religious contentions which followed was rendered still greater by the interference of the King of Spain, Philip III., who ordered his general, Spinola, to occupy the duchies of Cleves and Jülich for the count-palatine with a body of 30,000 Spaniards. But no sooner had his army entered these territories than the United States of the Netherlands, then at war with Spain, sent troops into the same countries under the pretence of occupying them for the Elector of Brandenburg (1614). The number of Lutherans and Calvinists having greatly increased in Bohemia, they shortly after claimed an extension of their religious liberties. The Emperor Matthias sent commissioners to Prague to communicate his refusal. Suddenly an armed party of Bohemian nobles rushed into the room and seized two of the commissioners, who with their secretary were precipitated from the windows, but they all escaped with their lives, and hastened back to Vienna.

May 21st, 1618, when this occurred, is regarded as the beginning of the Thirty Years' War. The insurgents in Bohemia immediately levied an army and organized a regular administration of the kingdom. The Emperor Matthias died soon afterwards (20th March, 1619), and Ferdinand II., archduke of Austrian Styria, succeeded him as emperor. Although he promised religious liberty to the Protestants of Bohemia, they nevertheless refused to accept him as king, and declared the throne vacant. Frederick V., elector palatine, the son-in-law of James I. of England, was chosen king, and crowned at Prague 4th November, 1619.

The Emperor Ferdinand II., assisted by his allies, adopted vigorous though arbitrary measures to recover Bohemia and her dependencies. At last the Bavarians, commanded by their duke and the celebrated Tilly, forced the Bohemians to make a stand on the Weisse Berg under the walls of Prague, and completely defeated them, 8th November, 1620. The Elector Frederick fled from his capital and took refuge in Holland. Towards the close of 1621 Bohemia with all her dependencies fell into the hands of the emperor, who punished the Bohemians severely. The Lutheran and Calvinist ministers were banished, and their churches shut up or given to the Roman Catholics. The Emperor put King Frederick under the ban of the empire, and declared his electorship forfeited.

In 1625 the war in Northern Germany was carried on by the troops of the Liga, and principally by those of Bavaria, under the leadership of Tilly, who was at the same time commander-in-chief of the imperial forces. On the other side, Ferdinand was threatened by Count Mansfeld, who was then at the head of a strong army in the duchies of Mecklenburg, and who was ready to invade Lusatia and Silesia, and to join Bethlem Gabor, prince of Transylvania.

In this conjuncture the emperor was saved by the genius and resources of his powerful subject Wallenstein, duke of Friesland, who defeated Mansfeld in several battles, and compelled Gabor to sue for peace. Tilly meanwhile carried on the war successfully in the country west of the Elbe against the King of Denmark. In 1628 he was joined by Wallenstein, and the campaign of the following year terminated in the treaty of Lübeck, 22nd May, 1629, when Wallenstein made a treaty with the King of Denmark on conditions unexpectedly favourable. Meantime, encouraged by the success of his armies, and misled by imprudent counsellors, Ferdinand II. (6th March, 1629) issued the "Edictum Restitutionis." By this decree he deprived the Calvinists of their religious liberties; and he declared that all bishoprics, abbeys, and churches taken from the Roman Catholics should be restored to them.

But a new and important actor now appeared on the scene in the person of Gustavus Adolphus, king of Sweden, who gradually occupied all Pomerania, and on 13th January, 1631, concluded a treaty with France, by which he engaged himself to carry on the war against Austria with 16,000 cavalry and 30,000 foot on the condition of an annual subsidy of 400,000 thalers. A sketch of the remainder of his triumphant career will be found under GUSTAVUS ADOLPHUS.

The death of their king at Lützen did not lessen the power of the Swedes nor change their politics; the chancellor Oxenstierna directed the conduct of the war with the same views, and the new generalissimo, Bernhard of Saxe-Weimar, was one of the most distinguished captains of his time. After the assassination of Wallenstein, 25th February, 1634, Ferdinand of Austria, the son and heir of the emperor, succeeded as commander-in-chief of the imperial and Bavarian armies. Reinforced by a corps of Spaniards he routed the Swedes at Nördlingen, 7th September, 1634, and Southern Germany fell into the hands of the imperialists. The Protestant princes now began to lose interest in the cause. Saxony concluded peace with the emperor, 30th May, 1635, at Prague; and Brandenburg gave in its adherence 27th August. By the end of

the year, out of all the Protestant states of importance, Hesse-Cassel, Würtemburg, and Baden alone continued their alliance with Sweden.

The most important event from 1635 to 1639 was the conquest of Alsace by Duke Bernhard of Saxe-Weimar. But on his death, 8th July, 1639, his army was bought by France, who immediately occupied Alsace. Meanwhile the Emperor Ferdinand II. had been succeeded by his son Ferdinand III. (1637). In 1640 the Swedes, under Banér, were driven from Bohemia. Banér died in May, 1641, and his successor was Torstensohn.

Torstensohn conquered, or rather traversed, in the spring of 1642, Saxony, Silesia, and Moravia, and his light horse appeared in the neighbourhood of Vienna. At the same time the French general, Marshal de Guébriand, penetrated into Swabia. Torstensohn was now compelled to retire to the north on account of a war with Denmark, and the French army was defeated and almost annihilated by the imperialists, on 24th November, 1643, near Duttlingen. France levied a new army, which was put under the command of Turenne, and reinforced by a body under Louis d'Enghien, afterwards Prince of Condé. They defeated the imperialists and obliged them to retire to the east of the Black Forest, leaving the Palatinate, Alsace, and Baden in the hands of the French (autumn, 1644). The imperialists were still more unfortunate in Eastern Germany. Torstensohn defeated them and the Saxons at Jankau in a bloody battle (March, 1645), and carried all before him. The Elector of Saxony and the Elector of Brandenburg now renounced their alliance with the emperor, and made their peace with Sweden, and their example was followed by the Elector of Bavaria. This was followed by a victory of the Swedes at Susmarshausen, near Augsburg (7th May, 1648). Königsmark, their general, invaded Bohemia, and on 31st July conquered that separate part of Prague which is called the Kleinseite. This conquest was the last important event of the Thirty Years' War, which ended, as it had begun, at Prague.

On the 14-24th of October, 1648, a double peace, which had been several years in negotiation, was concluded at Munster and at Osnabrück, under the name of the Peace of Westphalia. The principal conditions of the peace, after settling the cession of certain territories and rights to foreign powers and to members of the empire, were:—(1) The Treaty of Passau and the Second Peace of Religion were confirmed; (2) the religious quality of a territory or state was to be decided after the *status quo* of the 1st of January, 1624 (New Style); (3) equality of political rights between the Roman Catholics, the Lutherans, and the Calvinists or Reformed; (4) the Jus Reformandi was reduced to its original meaning as a mere protection of religion; (5) the ecclesiastical jurisdiction of the bishops was conferred upon the Protestant princes as a right of sovereignty, but in the Roman Catholic territories it remained in the hands of the bishops; (6) the princes acquired the right of concluding separate defensive and offensive alliances with foreign states; (7) the German Empire was changed into a kind of confederacy of almost sovereign states, the emperor becoming a mere director of the public affairs; (8) the Peace of Westphalia was guaranteed by Sweden and France.

The history of the Thirty Years' War has been written by Schiller, but in a somewhat fragmentary manner. See also Richelieu, "Memoirs;" Archbishop Trench, "Social Aspects of the Thirty Years' War" (1865); "Histoire de la Guerre de Trente Ans," by Charveriat (Paris, 1884), a very fine work; "History of the Thirty Years' War," by Gindely (English translation, London, 1877); and "Gustavus Adolphus," by Stevens (London, 1887).

THIRTY-NINE ARTICLES. At the era of the Reformation it was considered necessary, for the first time, to resort to the legislature for an authoritative exposition of the true Protestant faith, the establishment of appropriate forms of worship, and a declaration of the crown's supremacy in matters of religion. The Common Prayer-book and the Thirty-nine Articles of religion are *the legal* basis of the Reformation. Of these thirty-nine articles Lord Stowell says: "They are not the work of a dark age, as it has been represented. They are the production of men eminent for their erudition and attachment to the purity of true religion. They were formed by the chief luminaries of the Reformed Church with great care, in Convocation, as containing fundamental truths deducible in their judgment from Scripture; and the legislature has adopted and established them as the doctrines of our church down to the present time." The first draft of these articles was drawn up by Archbishop Cranmer, assisted by Bishop Ridley. After being corrected by the other bishops, Latimer, Hooper, Poynet, and Coverdale, they were published in the year 1552, Edward VI. being king. In the reign of Queen Elizabeth, and during the years 1562–63, Archbishop Parker reduced them to thirty-eight. At the convocation held in January, 1563, of which Alexander Nowell, dean of St. Paul's, was prolocutor, they were submitted, passed under further examination, and issued in Latin and English, signed by both Houses of Convocation. In the main they agreed with those set forth by Cranmer in the reign of Edward VI., though in some particulars they allow more liberty to dissenting judgment. "For instance," observes Fuller, "in the king's articles it is said that it is to be believed that Christ went down to hell, to preach to the spirits there, which clause is left out in these articles, and men left to a latitude concerning the cause, time, and manner of his descent." At a subsequent revision in 1571, Archbishop Parker restored the 29th article; and Convocation having again ratified them, the number of the articles was thus made thirty-nine. They were confirmed by Act of Parliament 13 Eliz. c. 12.

As the result of a royal commission which sat in 1864 to consider the subject of clerical subscription, an Act was passed in 1865 which laid down that on ordination or license the following subscription and no other should be necessary:—"I, A B, do solemnly make the following declaration. I assent to the Thirty-nine Articles of Religion, and to the Book of Common Prayer and of the Ordering of Bishops, Priests, and Deacons. I believe the doctrine of the United Church of England and Ireland, as therein set forth, to be agreeable to the Word of God; and in public prayer and administration of the Sacraments, I will use the form in the said book prescribed, and none other, except so far as shall be ordered by lawful authority." The canon was brought into agreement with the Act by letters patent, 1867.

With reference to the phraseology employed in the Thirty-nine Articles, and the intentions of their composers, it is interesting to revert to an opinion quaintly expressed by Thomas Fuller. He says: "Some have unjustly taxed the composers for too much favour extended in their large expressions, clean through the contexture of these articles, which should have tied men's consciences up closer in more strict and particularizing propositions, which indeed proceeded from their commendable moderation. Children's cloaths ought to be made of the biggest, because afterwards their bodies will grow up to their garments. Thus the articles of this English Protestant Church, in the infancy thereof, they thought good to draw up in general terms, foreseeing that posteritie would grow up to fill the same. I mean these holy men did prudently pre-discover that difference in judgment would unavoidably happen in the church, and were loath to unchurch any, and drive them off from the ecclesiastical communion for such petty differences, and which made them pen the articles in comprehensive words to take in all who, differing in the branches, meet in the root of the same religion."

THIS'BE. See PYRAMUS.

THISTLE is the common name of species of the genus Carduus and other genera belonging to the order of plants COMPOSITÆ, tribe Cynaroideæ. The thistles are herbs, often with perennial roots, with sessile alternate leaves, which are often much divided and prickly. The branches of the stem terminate in heads of flowers, with an ovoid or spherical involucre, the scales to which are imbricated in many rows, and tipped with a point or prickle. The flowers in the head are all tubular and similar, usually perfect, but sometimes diœcious; their usual colour is purple, but in some species they are yellowish or cream-coloured; the receptacle on which the flowers are placed is furnished with numerous soft bristles. The one-seeded achenes bear at the top a deciduous pappus, or tuft of numerous hairs, which are united into a ring at the base, and are often feathery, forming the well-known thistle down. The species are numerous, distributed over the temperate and colder parts of the northern hemisphere.

The Common or Spear Thistle (*Carduus lanceolatus*) is a large species found on waste ground, and growing to a height of 3 or 4 feet. The leaves are large, much divided, spiny, and decurrent (the blade being prolonged down the stem); they are prickly on the upper surface, and covered with short hairs on the lower. The flower-heads are large, terminal, solitary, or two or three together; the flowers are purple. This is one of the species regarded as the Scotch thistle, though probably the national emblem of Scotland, like the shamrock of Ireland, cannot be referred to any one botanical species. The Musk-thistle (*Carduus nutans*) is a common plant on waste ground, in dry, stony, or chalky soils, in Great Britain. It gives out, especially in the evening in warm weather, a strong smell of musk. It is about 2 feet high, with the upper part of its stalk almost bare of leaves. The flower-heads are large, solitary, drooping, and of a rich purple colour. The Creeping or Plume Thistle (*Carduus arvensis*) is a very troublesome weed in fields, as it spreads rapidly by means of its long creeping root-stocks, and is very difficult to eradicate. It is a native of Britain, and of Europe generally, and has been introduced into nearly all cultivated parts of the world. The stems are from 18 inches to 3 feet high, and bear loose terminal corymbs of diœcious pale lilac-coloured flower-heads. The Ground or Stemless Thistle (*Carduus acaulis*), with a fibrous root, no stem, large radical leaves, and very large crimson flower-heads, is in some parts of Scotland regarded as the Scotch thistle. The Blessed Thistle (*Cnicus benedictus*) is a native of the Levant and Persia, and in the middle ages was held in extravagant estimation on account of its supposed virtues. It is still cultivated in some places on account of its medicinal properties. The Cotton Thistle (*Onopordon acanthium*) belongs to a genus distinguished by its honeycombed receptacle. It is found in dry waste places in England and Ireland, but is not a true native of Scotland, though it is sometimes called the Scotch thistle. It has an erect stem, from 3 to 5 feet high, woolly and broadly winged, large woolly very spiny leaves, and many large dull purple flower-heads, of which the involucre is globose and somewhat cottony. The Carline Thistle belongs to the genus Carlina, which obtained that name from a tradition that the root of the Common Carline (*Carlina vulgaris*) was shown by an angel to Charlemagne as a remedy for the plague which prevailed in his army. *Carlina vulgaris* is a weed common in Britain on dry sandy heaths. It is about a foot high, and is remarkable for the hygrometric properties of the cream-coloured involucre, which spreads horizontally in dry weather and becomes erect during rain.

The STAR THISTLE is *Centaurea calcitrapa*. The Milk, Holy, or Our Lady's Thistle is SILYBUM *marianum*. The Sow THISTLES belong to the genus Sonchus.

Some of the species of thistles are admitted into gardens. They form a pretty variety for borders, and require little care in their cultivation.

THISTLE, ORDER OF THE. See ORDERS OF MERIT.

THISTLEWOOD'S CONSPIRACY, a nefarious plot for the assassination of the ministers of the crown at a cabinet dinner, devised by Arthur Thistlewood and a gang of needy adventurers, who held their meetings in Cato Street, Edgeware Road, London. Their designs were betrayed by one of their number, and the conspirators arrested 23rd February, 1820. Thistlewood and his co-leaders, Brunt, Ings, Davidson, and Tidd, were executed with all the horrors attending the punishment of high treason, on the 1st of May following.

THLAS'PI is a genus of plants belonging to the order CRUCIFERÆ, and tribe Thlaspideæ. *Thlaspi arvense* (penny cress) is native throughout Europe and in England, occurring as a tolerably common weed in cornfields and by roadsides. It has a slender stem about a foot in height, with bright green, oblong-toothed leaves, arrow-shaped at the base. The flowers are small and white, and the whole plant when bruised has a somewhat garlic like odour. The fruit is a large orbicular pouch. *Thlaspi perfoliatum* is a native of Europe, and is found in England on a chalky soil. *Thlaspi alpestre* is found on mountain limestone pastures throughout Europe and England.

THOMAS AQUINAS, ST. See AQUINAS.

THOMAS, ST., one of the Virgin Islands, West Indies, belonging to Denmark, 38 miles east from Porto Rico. The greatest length from east to west is 17 miles, and the greatest breadth about 4½ miles; area, 45 square miles. It has a rugged and elevated surface, which attains its greatest height towards the centre, and descends sometimes gradually, but oftener abruptly, to the shore. It was once well wooded, but the cutting down of the trees has laid it open to the full force of the sun's rays, and it now suffers much from the deficiency of water. The soil being sandy and by no means fertile, the far greater part of it remains uncultivated. Since the emancipation of the slaves in 1847, the cultivation of sugar has been entirely abandoned. An attempt to grow cotton failed in consequence of the high price of labour. The whole colony enjoys the privileges of a free harbour, and the trade in consequence is extensive, St. Thomas being a depot for goods for many of the neighbouring islands. Its capital, Charlotte Amalie or St. Thomas, is its trade centre. A Spanish line of steamers makes regular fortnightly voyages between the various ports of Cuba, Porto Rico, and St. Thomas, and its tendency is to become simply a port of call, for which it possesses very great natural advantages. The whole island contains 13,000 inhabitants, of whom 1300 only are pure white. It enjoys a warm but temperate climate, in which the thermometer varies little outside 70° to 90°. The port has an excellent habour, which is kept well dredged. It is landlocked on three sides, and fortified at its entrance. A floating dock was completed in 1876. The streets are rather narrow, but the general appearance of the town from the sea is very striking, the houses, which rise tier above tier on the side of the hill, being built of a cream coloured limestone and gaily decorated. The English language is that chiefly spoken. The majority of the inhabitants are Protestants, and there are several churches and some good hotels and stores. Cattle and provisions to supply the wants of the inhabitants and the shipping calling at the port are chiefly brought from Ste. Croix, Porto Rico, and other adjacent islands. The curse of the town is the frequent prevalence of yellow fever, which, however, does not much affect the natives, but often proves fatal to the crews and passengers of vessels. A tornado peculiar to these latitudes swept with irresistible violence over this island on the 29th October, 1867, caus-

ing a fearful loss of life and property. On this occasion four steamers belonging to the Royal Mail Company—the Rhone, the Wye, the Conway, and the Derwent—besides upwards of sixty other vessels, either foundered or were driven ashore.

THOMAS, ST., THE APOSTLE, according to tradition, was born at Antioch. In the lists of the Synoptic gospels his name is associated with that of Matthew, but in the Acts of the Apostles he is coupled with Philip (Matt. x. 3; Mark iii. 18; Luke vi. 15; and Acts i. 13). For what we know of his character we are indebted to the Gospel of St. John, which contains three incidents in his life, and these have sufficed to give him a prominent place as "doubting Thomas" in all subsequent comments on the character of the apostle. It is plain, however, from these incidents that along with his slowness to believe he possessed fidelity and affection, these characteristics being strongly displayed in his appeal to his fellow-disciples, recorded John xi. 16. There is no further mention of him after that of Acts i. 13 in the New Testament, but the earlier traditions of the church represent him as preaching the gospel in Parthia or Persia, and as being finally buried at Edessa. Later traditions carry him further East, and represent him as suffering martyrdom, being put to death by a thrust from a lance.

THOMPSON, LIEUT.-GENERAL THOMAS PERRONET, an English political reformer, born at Hull on the 15th of March, 1783. In 1803 he entered the navy as midshipman, and in 1806 went into the army as second lieutenant. In 1808 he was made governor of Sierra Leone. One of his first acts was to issue a proclamation for the suppression of the slave trade in the colony; and the opposition raised against him by the slave-traders caused his recall. He arrived in England in 1810, returned to the army, and served in the Peninsular campaign of 1813, in France in 1814, and afterwards in the Pindaree campaign in India. In 1819, having learned Arabic, he accompanied Sir William Keir Grant in the expedition up the Persian Gulf, and assisted in the negotiation of the treaty with the Arab tribes by which the slave trade was declared piracy. In 1854 he was made major-general. In 1814 he published a work entitled "On a Constitution." He was one of the contributors to the *Westminster Review* on its establishment in 1824, and five years afterwards became joint proprietor, writing for it constantly till 1836. His "Corn-Law Catechism" (1827) was the most effective attack upon the protectionist system. He was several times elected to Parliament. A selection from his miscellaneous writings was published (six vols. 1842). He spent much time in the scientific investigation of music, and had a small organ constructed at his own expense to demonstrate a variety of temperament which he advocated as approaching more nearly to just intonation than the ordinary equal temperament, while not being so complicated as to be unworkable. This instrument, though somewhat out of order, is still extant, but musicians declined to follow General Thompson's lead in the matter. He died 6th September, 1869.

THOMSON, JAMES, a British poet, and author of "The Seasons," born at Ednam, Roxburghshire, Scotland, 11th September, 1700, died at Kew Lane, near Richmond, 27th August, 1748. He published in March, 1726, his blank verse poem of "Winter," for the copyright of which he received three guineas, and three editions were called for in a year. In 1727 appeared "Summer," followed by "Britannia" and a "Poem sacred to the Memory of Sir Isaac Newton;" in 1728, "Spring;" and in 1730, "The Seasons," completed by the addition of "Autumn," in a 4to volume, of which 454 copies were subscribed for at a guinea each. In 1729 he produced "Sophonisba," a tragedy, acted with moderate success at Drury Lane. Subsequently he produced successively his dramas "Agamemnon" (1738), which narrowly escaped being ruined on the first night, and "Edward and Eleanora," the representation of which was prohibited under the operation of the Act for licensing dramatic performances; the masque of "Alfred," written in conjunction with Mallet, which contains the celebrated song and chorus, "Rule Britannia," set to music by Dr. Arne; and "Tancred and Sigismunda," performed with success at Drury Lane in 1745. In 1748 appeared "The Castle of Indolence," on which he had laboured for many years. His posthumous play of "Coriolanus" was performed at Covent Garden.

Thomson's taste was not always equal to his genius, and his diction is frequently redundant and ambitious; but, as Johnson observes, "he thinks in a peculiar train, and he thinks always as a man of genius; he looks round on nature and life with the eye which nature bestows only on a poet—the eye that distinguishes in everything presented to its view whatever there is on which imagination can delight to be detained, and with a mind that at once comprehends the vast, and attends to the minute." His sentiments are of a pure and elevating character, and, as Lord Lyttelton justly remarked, his poems contain

"No line which, dying, he could wish to blot."

All his friends agree in stating that benevolence, kindliness, amiability, and simplicity were the prominent features of his character. He was careless about money, generous, and unselfish; affectionate and liberal to his relations, and steady in his attachment to his friends. He was, however, fond of repose, and somewhat indolent in his habits. In person he was above the middle size and rather stout, and was considered handsome in his youth.

THOR (Old Norse, *Thórr*, contracted from *Thonar*, *i.e.* thunder), in the Norse mythology, a son of Odin and Earth (Yörd), the god of war, and consequently the leader and defender of his fellow-divinities in their struggle with the giants. His principal weapon, which in some respects seems the secret of his might, was the famous red-hot hammer Mjölnir. He had also a pair of steel gauntlets, and a belt which, when he wore it, doubled his strength. He is represented as driving a golden chariot, drawn by two he-goats, which, as it sped along the heavenly path, caused thunder and lightning. His name is preserved in our English Thursday, or Thor's day.

THORACIC DUCT is the principal trunk of the lymphatic or absorbent system, and the canal through which the greater part of the chyle and lymph is conveyed into the blood. It is about the size of a crowquill, and lies along the whole course of the spine, just in front of it; and it discharges itself into the left subclavian vein at the shoulder, where the internal jugular vein joins it.

THORAX. See Chest.

THOR'EAU, HENRY DAVID, an American author, born in Concord, Mass., 12th July, 1817, died there, 6th May, 1862. He graduated at Harvard College in 1837, and after teaching school for a short time became a land surveyor. In this pursuit he worked no more than was necessary to gain the means for his simple wants, and devoted most of his time to reading, writing, pedestrian excursions, and study. Emerson says of him, "Few lives contain so many renunciations. He was bred to no profession, he never married, he lived alone, he never went to church, he never voted, he refused to pay a tax to the state, he ate no flesh, he drank no wine, he never knew the use of tobacco, and, though a naturalist, he used neither trap nor gun." In 1845 he built a small frame house on the shore of Walden Pond, Concord, and lived in it alone for two years, working and studying. He published "A Week on the Concord and Merrimack Rivers" (Boston, 1849), and "Walden, or Life in the Woods" (1854). After his death were published "Excursions in Field and Forest," with a biographical sketch by R. W. Emerson

(1863); "The Maine Woods" (1864); "Cape Cod" (1865); "Letters to Various Persons," with nine poems (1865); and "A Yankee in Canada," with anti-slavery and reform papers (1866). See "Thoreau, the Poet-Naturalist," by William Ellery Channing (Boston, 1873).

THORI'NUM or **THORIUM** is a rare metal, belonging to the calcium group. It was discovered by Berzelius in 1828 in thorite. It is also found in pyrochlore, monozite, orangeite, luxenite, gadolinite, and orthite. The metal is obtained from the chloride by treating it with sodium. It then presents the appearance of a gray metallic powder. The specific gravity is 7·657, the symbol Th, and the atomic weight 115·72. It burns brilliantly when heated, and forms a snow-white powder, which is the oxide thorina. Thorinum is not oxidized by water; it is but slowly attacked by nitric and sulphuric acids, and is not at all acted on by caustic alkalies. It is, however, readily soluble in hydrochloric acid. There is only one oxide of thorinum, which is called thorina (ThO). It is a heavy white powder, having the specific gravity 9·20. It is insoluble in nitric and hydrochloric acids, and dissolves only by boiling sulphuric acid. The hydrate of this oxide is obtained as a gelatinous precipitate when a caustic alkali is added to solutions of thorinum salts. It is readily soluble in all the mineral acids except hydrofluoric.

The chloride of thorinum ($ThCl_2$) is obtained as a white crystalline sublimate, by heating a mixture of thorina and charcoal in a stream of chlorine gas. The crystals are deliquescent and soluble in water, raising the temperature. In the liquid form it may be obtained by dissolving thorina hydrate in hydrochloric acid. It forms double chlorides with the chlorides of potassium and ammonium. The bromide of thorinum ($ThBr_2$) and the iodide (ThI_2) are both crystallizable with difficulty. The fluoride ($ThFl_2$) is a heavy insoluble powder. The sulphide (ThS) is a dense black mass, having the high specific gravity 8·29. The thorinum salts are generally colourless; the acetate crystallizes in needles, insoluble in water, and having the formula $Th(C_2H_3O_2)_2$. The carbonate ($ThCO_3 3ThH_2O^2H_2O$) is a white amorphous precipitate.

Thorinum is detected by the infusibility of its oxide before the blowpipe, and in solution by its forming a precipitate with oxalate of ammonium, with hyposulphite of sodium, and with sulphate of potassium. It is usually estimated as oxide, which is precipitated by ammonia as a hydrate, and ignited, giving the pure oxide.

THORN, an Old English letter representing *th*, which it is much to be regretted has passed out of actual use. The thorn (Þ) was a Runic letter introduced because there was no sign for *th* in the Roman alphabet, and the English speech, then as now, abounded in that consonant. Another form for *th* was ð, a crossed *d*, both forms standing for what is usually phonetically expressed by *dh*, that is, for the *th* in *then*. But whereas the former never represented the light *th* (as in *think*) the latter occasionally served for this purpose. Usually an Early English writer used either the one form throughout or the other. Modern philosophers sometimes use the two letters to represent *dh* and *th* respectively.

THORN. See CRATÆGUS and SPINE.

THORN-APPLE. See DATURA.

THORNBACK (*Raja clavata*) is a species of cartilaginous fish belonging to the family Rajidæ, order Batoidei. [See RAYS.] The thornbank is well known, as occurring almost as frequently on the British coast as the skate. It is taken in most abundance in comparatively shallow water, in spring and early summer, about the spawning time, but its flesh is not in such good condition at that season as in November. It is also common in the Mediterranean and extends to Madeira. The whole upper surface of this species is rough with small points set in a flattened stellate base, and distributed among these are many nail-like tubercular spines of a larger size, set on oval horny plates, and directed backwards. These spines extend down the tail in a median line, and are much more abundant in the female than in the male. This armature gives the name thornback to the species. It attains a large size, between 3 and 4 feet long and about 2½ feet broad. The body is nearly rhombic, the muzzle being slightly produced. The front margins of the pectoral fins are undulated; the outline behind each lateral angle is nearly straight, or slightly rounded; the eyes and temporal orifices are rather large, guarded before and behind by strong hooked spines. The tail is long and is furnished with two membranous fins on the upper ridge, and ends with a small flattened point. The colour is brown above and white below, the upper part being marked with numerous white spots. The teeth of the thornback deserve to be noticed. When young they are the same both in the males and females; but when full grown those of the male lose the flattened surface and [illegible] nted by [illegible] of the [illegible] gle, all the points being directed towards the throat. The th[illegible] back preys on other fish, particularly flat fish, molluscs, and crustaceans.

THORNHILL, SIR JAMES, an artist of some eminence, was born at Weymouth in 1676, and was descended from an ancient family in Dorsetshire, but through the extravagance of his father was compelled to support himself by his own exertions. He adopted the profession of a painter, travelled to France and modelled his style upon the then fashionable style of Le Brun. Queen Anne engaged him to paint the interior of the dome of St. Paul's Cathedral, and afterwards the princess' apartment at Hampton Court. He executed many other large works connected with the staircase, the gallery, and several ceilings in the palace at Kensington, the hall at Blenheim, several altar-pieces, ceilings, &c., at Oxford, and (with some assistance) the great hall at Greenwich Hospital. In 1724 he opened an academy for drawing at his house in Covent Garden. He had previously proposed the foundation of a royal academy of the arts, with apartments for professors, but without result. Thornhill died in 1734. He left a son, who had been appointed serjeant painter and painter to the navy; and one daughter, who was married to Hogarth. Sir James Thornhill amassed considerable property, was a fellow of the Royal Society, and represented Weymouth in Parliament for several years until his death. He was knighted by George I., and was the first English painter to receive that honour.

THOR'NYCROFT, MRS., an English sculptor, born at Thornham, Norfolk, in 1814. She was a pupil of her father, John Francis (1780–1861), who attained great eminence in London as a portrait sculptor, and executed busts of Queen Victoria, Prince Albert, Wellington, and many of the statesmen of his time. In 1840 she married Mr. Thornycroft, also a pupil of her father, and in 1842 accompanied him to Rome, where she received instructions from Thorwaldsen and Gibson. After her return in 1843 she was employed to execute statues of four of the royal children in the character of the four seasons. Her best known works include "The Flower Girl," "Sappho," "Sleeping Child," and "Girl Skipping." Her still more talented son Mr. Hamo Thornycroft is among the most distinguished of contemporary sculptors.

THOROUGH-BASS, the art of playing (on keyed instruments, and according to the rules of harmony) an accompaniment from figures representing chords, such figures being placed either over or under the notes of the instrumental bass staff. See FIGURED BASS.

THOR'WALDSEN, BERTEL (*Albert*), was born 19th November, 1770, at Copenhagen. He was the son of a poor wood-carver of Iceland. Thorwaldsen showed genius in carving from a mere child. In 1793 he obtained the principal gold medal of the Danish Academy, with the

privilege of studying for three years abroad at the government's expense. After some preliminary study, and various delays on the journey, he arrived at Rome, 8th March, 1797. Thorwaldsen suffered much from neglect and poverty; and was only saved by the liberality of Thomas Hope, who gave him 800 ducats for a marble copy of his Jason, afterwards recognized as a real masterpiece. From this time his star was in the ascendant, and commissions crowded in from all sides.

In July, 1819, Thorwaldsen started in the company of two friends on his first visit to his native city, where he was lodged in the palace of Charlottenburg and entertained with public feasts. In about a year he left Copenhagen again for Rome.

He executed his principal works after his return—as "Christ and the Twelve Disciples," the group of "St. John in the Wilderness," and the monuments to Copernicus, Pius VII., Maximilian of Bavaria, and Poniatowski. His famous "Dying Lion" at Lucerne, to the memory of the massacred Swiss Guard of Louis XVI. of France, was sculptured in 1821. In 1838 the "Christ," the "St. John preaching," and the "Apostles"—the principal works for the cathedral or church of Our Lady at Copenhagen—and others for the palace of Christiansburg, were completed, and the Danish government sent the frigate *Rota* to carry them and their sculptor to Copenhagen. Thorwaldsen intended to return to Rome in the summer of 1844, the climate of the north being prejudicial to his health, but died suddenly in the theatre of Copenhagen, 24th March, 1844. His body lay in state in the Academy, and was buried with extraordinary ceremony in the cathedral church.

Thorwaldsen is considered by his admirers the greatest of modern sculptors, and many have not hesitated to place him far above Canova, and to compare him with the antique. This is, however, hardly the rank he will hold with posterity. His style is uniform to monotony, though many individual figures are bold, solid, and of beautiful proportions. The well known statue of Lord Byron by Thorwaldsen in the library of Trinity College, Cambridge, was intended to be placed in Westminster Abbey, but permission was refused by two successive deans, and in consequence it was removed to Cambridge. Thorwaldsen's bas reliefs of "Day and Night," of the "Four Seasons," &c., are among the loveliest works of their kind.

The life of Thorwaldsen has been written by Hans Christian Andersen; by J. M. Thiele, whose work was translated into English by the Rev. M. E. Barnard in 1865; and by Plon, translated by Mrs. Cashel Hoey, 1874.

THOTH, the Egyptian god of letters, was the recording angel of that gloomy religion, reporting the worldly deeds of souls after their death, and writing down the judgment of Osiris. He bears the head of an ibis, carries a tablet, a pen, and a palm branch. The ibis was sacred to him, and to kill it was punished with death.

Thoth is likewise the name given to a species of baboon, under whose form the Egyptian god was also worshipped. This baboon, which is commonly represented on Egyptian sculptures, has been identified with the SACRED BABOON (*Cynocephalus hamadryas*).

THOU, JACQUES-AUGUSTE DE, born at Paris, 8th October, 1553, was the third son of Christopher de Thou, first president of the parlement of Paris. Originally destined for the church on account of the delicacy of his health, De Thou eventually became a lawyer, and in 1856 was *maître des requêtes*, &c., one of the *présidents au mortier* in the parlement of Paris. When, in the next year, in the increasing distractions of the state, Henry III. found himself obliged to leave Paris, De Thou accompanied his majesty to Normandy, and afterwards to Picardy. At Chartres, in August, 1583, he was admitted a counsellor of state; and from this date he took a leading part in all the principal public transactions which followed, being distinguished throughout for his adherence to the crown. After the accession of Henry IV. he was constantly with the king, or employed on missions to different quarters in his service. Among other important transactions in which he had a part was that of the Edict of Nantes, published in 1598, which he was greatly instrumental in arranging. He has left an account of his own life, in ample detail, down to 1601. In 1604 he published the first eighteen books of the history of his own time (in Latin), which he called "Thuana," and which he had commenced in 1593, and conceived in his mind fifteen years before. The work was at first received with general approval, but in 1609, when the second portion of it had been published, it was formally stigmatized by being inserted in the "Index Expurgatorius." It is of the very greatest value historically, and is written with elegance, for De Thou was a scholar of high rank, enjoying the friendship and respect of the great Scaliger on this account. De Thou died at Paris on the 7th of May, 1617. He had been president of the parlement since 1594.

THOUGHT. See THINKING.

THOUGHT-READING. From about the year 1881 very remarkable experiments have been made in what is called thought-reading. Amidst much trickery a few curious facts have certainly been discovered. A person blindfolded could discover a hidden object if he were allowed to lead by the hand one who knew its whereabouts, the involuntary motions of the person led betraying his thoughts. A daughter could write words or draw sketches shown to her mother, but not visible to herself, provided her mother touched her bare arm; a whole family of children could tell words and figures in the observer's mind, but unspoken. These things were closely examined and tested, with numberless others like them, by competent professors and men of science. As yet no trustworthy theory or generalization has been made, though many imaginative persons have been led to believe in the existence of brain-waves perceptible to sensitive organisms just as light waves are to ordinary eyes.

THOUSAND AND ONE NIGHTS, THE, or more correctly the *Thousand Nights and a Night*, is a famous collection of Oriental tales, often called the ARABIAN NIGHTS. In 1885 appeared at Benares the famous English translation by Sir Richard Burton, in ten vols., a marvel of erudition, of clever imitation of the peculiar features of style of the original, and of exact translation. It was printed privately for subscribers only, because the licence quite usual in the East renders passages here and there unfit for the general English reader. Lady Burton accordingly caused an expurgated edition to be prepared. This was issued in 1887 under her guarantee that all improprieties had been expunged. After all only 215 pages out of 3215 were altered. The difference between this translation and that of Lane is that between a poem and a paraphrase.

THRACE (Gr. *Thrakê*, Lat. *Thracia*), in earlier times the name of the present district of Roumelia, in European Turkey. It was bounded on the N. by the Danube, on the S. by the Propontis and the Ægean Sea, on the E. by the Black Sea, and on the W. by the river Strymon and the chain of mountains which forms the continuation of Mount Rhodope. The country is divided in two by the Hæmus or Balkan Mountains, which run from west to east, separating the plain of the lower Danube from the rivers which flow into the Ægean Sea. Two extensive ranges branch off from the southern side of the Balkans—one at about 100 miles from the Euxine, which runs in a south-eastern direction towards Constantinople; the other, which is far larger, branches off near the source of the Hebros, and likewise runs to the south-east. The latter bore the name of Rhodopê, and is now called the Despoto Mountains. Between these two ranges there are many plains, which are drained by the Hebros (the Maritza), the principal river of Thrace, and its tributaries.

In ancient times there was a great quantity of corn and wine grown in the valley of the Hebros. In the Iliad the ships of the Achaians are described as bringing wine every day to Agamemnon from Thrace (ix. 72); and the Maroneau wine, which retained its reputation in the time of Pliny ("Hist. Nat." xiv. 6), is spoken of in the Odyssey (ix. 197). In the mountainous parts of the country there were also mines of precious metals.

The Thracians were divided into many independent tribes; but the name seems to have been applied to them collectively in very early times. The Thracian nation, according to Herodotos (v. 3), was, next to the Indians, the most numerous of all, and if united under one head would have been invincible. He describes them as a barbarous people who sold their children as slaves. They were temporarily conquered by Dareios I., king of Persia, with the exception of one tribe. During the Peloponnesian War, which began B.C. 431, there was a powerful Thracian Empire under a King Sital-kês; and we often read of the Thracians during the contests between Athens and Macedonia. Philip, the father of Alexander, reduced the whole of southern Thrace to subjection, B.C. 343, and compelled it to pay tribute. Under Alexander the Great the Thracians attempted to throw off the yoke, but the young king promptly checked the rising. On the death of Alexander, Thrace fell to the share of Lysimachos, who erected it into an independent monarchy; but it subsequently came under the dominion of the Macedonian kings. In the Roman war against Perseus, Cotys, king of the Thracians, is mentioned as an ally of Perseus; though the Thracians, just before the war broke out, had sought the alliance of the Romans. On the conclusion of the war, however, Cotys was allowed to continue in possession of his kingdom, notwithstanding the assistance he had rendered to Perseus.

At what time Thrace was reduced to the form of a Roman province is uncertain, but it seems not to have occurred till a late period. Under Augustus, the district north of the Balkans was conquered by the Romans, and was afterwards erected into a separate province under the name of Mœsia. The name of Thrace was then confined to the country south of the Balkans, and between the Euxine, the Propontis, and the Ægean Sea. Its boundary on the west differed at various periods: in the time of Ptolemy it seems to have been the Nestos; but anciently it was divided from Macedonia by the Strumôn.

THRALE, MRS. (1739-1831), the friend of Dr. Johnson, was of Welsh parentage. Her maiden name was Hester Lynch Salisbury. After the death of Mr. Thrale, the brewer, she married Piozzi, the musician. See PIOZZI, HESTER LYNCH.

THRALL, the slave of the early English invaders of Britain, otherwise called *theow*. The thralls were of two kinds, the *wealh*, or hereditary slaves, the ancient Britons and their descendants, who were fairly numerous in the western parts of the land; and the *wite theows*, degraded *ceorls*, criminals or forfeited men, or those who had not paid a blood-fine or other pecuniary punishment. Our forefathers made criminals useful in this way, instead of locking them up in herds at the cost of the community. The thralls were the absolute property of their owners, who sold them, however, only with the land as a rule. A sale of thralls as slaves was not at all common, though instances of this exist. In Kent were some semi-thralls called *laets*, who were attached to the land without being its owners, but who enjoyed the produce of it subject to certain duty-work and other imposts due to their superior ceorls or corls.

THRA'SEA PÆTUS, PUBLIUS, was born of a noble and wealthy family at Patavium, or Padua, about A.D. 16. He held the tenets of the Stoics, and was remarkable for the integrity and purity of his life, as well as for his attachment to ancient institutions. By venturing to oppose in the Senate some of the most flagitious of Nero's measures, he made that tyrant his mortal enemy. He was condemned to death in 66, on a false charge of being implicated in the conspiracy of Piso. His wife, Arria, killed herself at the same time, being resolved not to survive her husband. Tacitus, speaking of the event, says, "Thus Nero determined to murder virtue herself," so high in his opinion ranked the character of Thrasea.

THRASHING MACHINE. See AGRICULTURAL IMPLEMENTS

THRASUBOU'LOS, an eminent Athenian commander, was a zealous supporter of the Athenian democracy, and took an active part in opposing the oligarchical revolution in 411 B.C. He succeeded in overthrowing the partisans of the Four Hundred in the camp at Samos, and obtained the recall of Alcibiades, then an exile at Magnesia. He greatly distinguished himself at the battle of Arginusai. On the re-establishment of the thirty tyrants at Athens, Thrasuboulos was driven into exile and took refuge at Thebes. Having obtained a supply of arms and money from the Thebans, he put himself at the head of a small band of exiles, and seized the fortress of Phulê, 404 B.C. Encouraged by this success, he marched upon the Peiraios, which fell into his hands; and after a war which lasted several months he expelled the tyrants, and restored democracy at Athens, 403 B.C. He afterwards commanded the Athenian fleet in the Ægean, and gained several victories; but he was slain by the inhabitants of Aspendos, 390 B.C. He was one of the wisest, most moderate, and generous citizens of Athens.

THRASYBU'LUS, the Latin form of THRASUBOULOS.

THRASYME'NE, LAKE, or **TRASIMENUS,** now called the *Lake of Perugia*, a lake in Etruria, near Perusia (Perugia), on whose banks Hannibal decoyed the Roman army into a defile, and inflicted a disastrous defeat upon the Consul Flamininus, B.C. 217.

THREAD, a small line formed by twisting together fibres of vegetable or animal substances, as flax, cotton, or silk. Sewing thread, and the various kinds of thread used in the manufacture of bobbinet, lace, and some other kinds of textile fabric, consist of two or more *yarns*, or simple spun threads, firmly united together by twisting, just as a rope-strand consists of several yarns or distinct cylinders of hemp.

The operation of combining yarns of cotton or linen into thread is performed by a machine called a doubling and twisting frame, somewhat resembling the throstle of the cotton-spinner. Along the centre of the machine is an elevated creel or framework, which supports two parallel rows of cops or bobbins of yarn, one row towards each side. From the cops the yarns are conducted over horizontal glass rods, fixed parallel with the creel, and thence downward into troughs filled with water or very thin starch paste, which by moistening the yarns facilitates the subsequent process of twisting. After being wetted, the yarns pass over the rounded edge of the trough, which is covered with flannel for the purpose of absorbing the superfluous moisture; and thence under and partly around an iron roller, made to revolve with any required velocity by a train of wheel-work. Upon this roller rests another, of box-wood, which revolves slowly by contact with the iron roller, its axis playing in vertical slots. In passing under the iron roller, then between it and the wooden roller, and finally over the latter, the yarns required to form the thread are brought together and slightly compressed; and they are finally twisted by apparatus very like that used in throstle spinning, and afterwards polished in various ways.

THREAD-WORMS. See NEMATODA.

THREATS and **THREATENING LETTERS.** Threats of personal violence, or any other threats by which a man of ordinary firmness and prudence may be put in fear, and by means of which money or other property is

extorted from him, amount to robbery. By the 24 & 25 Vict. c. 96, s. 44, a person demanding by menaces any property of another with intent to steal the same, is declared to be guilty of felony, and is liable to penal servitude for life, or imprisonment for any term not exceeding two years. It is a misdemeanour at common law to threaten another in order to deter him from doing some lawful act, or to compel him to do an unlawful one, or to extort money or goods from him, or to obtain any other benefit to the person who makes the threat.

The offence of sending or delivering letters or writings, threatening to kill or injure the person to whom they are sent or delivered, or to burn his house, or to accuse him of some heinous crime, for the purpose of extorting money, was formerly considered to be high treason (Statute 8 Henry V. c. 6); and under the Statute 9 Geo. I. c. 22, continued for more than a century to be punishable as a capital felony. But by the 4 Geo. IV. c. 54, s. 3, it was enacted that "if any person shall knowingly and wilfully send or deliver any writing, with or without any name or signature subscribed thereto, or with a fictitious name or signature, threatening to kill or murder any person, or to burn or destroy his house, outhouse, barns, or stacks of corn or grain, hay or straw, the offender shall be guilty of felony, punishable with transportation for life or not less than seven years, or imprisonment for any term not exceeding seven years." These offences are now regulated by the 24 & 25 Vict. c. 97, s. 50, and 24 & 25 Vict. c. 100, s. 16, the punishments being, in the case of threatening to murder, penal servitude not exceeding ten nor less than three years, or imprisonment not exceeding two years with or without hard labour, or with or without solitary confinement, and if a male under the age of sixteen, with or without a whipping. The same punishments are enacted in the cases of threatening to burn a house, &c. By the 7 & 8 Geo. IV. c. 29, s. 8, it was enacted that, "if any person shall knowingly send or deliver any letter or writing, demanding of any person with menaces, and without any reasonable or probable cause, any chattel, money, or valuable security; or if any person shall accuse, or threaten to accuse, or shall knowingly send or deliver any letter or writing accusing or threatening to accuse any person of any crime punishable by law with death, transportation, or pillory, or of any assault with intent to commit any rape, or of any attempt or endeavour to commit any rape, or of any infamous crime (the meaning of which term is specially defined in the ninth section of the same statute), with a view or intent to extort or gain from such person any chattel, money, or valuable security," every such offender shall be guilty of felony, and shall be punishable with transportation for life or not less than seven years, or with imprisonment not exceeding four years, with or without whipping. This offence is now regulated by the 24 & 25 Vict. c. 96, s. 46, and the punishments are penal servitude for life or not less than three years, or imprisonment not exceeding two years with or without hard labour, and with or without solitary confinement, and in the case of a male under sixteen, with or without whipping, according to the discretion of the judge.

The various statutes above cited do not apply to Scotland. Using threats verbally, and sending letters threatening to do serious injury to any person, or to his property or reputation, are offences punishable at common law. Persons against whom threats are used may obtain interdict against the threatener, or may by a process called *lawburrows* (which is very seldom used), get an order from the sheriff court compelling him to find security to keep the peace under penalty of imprisonment.

THREE PER CENTS or **CONSOLS**, that part of the Consolidated Debt [see NATIONAL DEBT] which arose in 1752 in consequence of the annuities granted under the government of George I. being now consolidated (under George III.) into one fund, together with a three per cent. fund formed in 1731. In 1887 the Three per Cents. stood in all at £325,381,154.

THREE PER CENTS. REDUCED is a stock formerly bearing 4 per cent. interest down to 1750, when it was reduced to 3½ per cent. In 1757 it was further reduced to 3 per cent. In 1887 the Reduced Threes stood in all at £77,436,924.

NEW THREE PER CENTS., or in full "New Three per cent. Annuities," another similar fund, stood in 1887 at £157,488,871. All these stocks were, in 1888, converted to a new stock bearing interest at 3 per cent. until 5th April, 1889, then at 2¾ per cent. until 5th April, 1903, and thereafter at 2½ per cent. until 1923. A bonus of 5*s.* per cent. was paid in addition to holders of consolidated three per cent. annuities who assented to the terms of conversion.

THREE, RULE OF. See RULE OF THREE.

THREN'ODY (Gr. *thrênos*, a dirge, and *ôdê*, a song), a short occasional poem commemorating the death of some illustrious personage.

THRESHER. See FOX-SHARK.

THRIFT (Armeria) is a genus of plants of the order PLUMBAGINEÆ. The Common Thrift or Sea-pink (*Armeria vulgaris*) is common along the sea-shore in all parts of Britain, and also occurs on many of the mountains. It is also distributed generally throughout Europe. It grows in turf-like tufts with narrow linear radical leaves and short flowering stems, which terminate in compact heads, surrounded by an involucre of bracts, forming an inverted cylindrical sheath. The flowers are rose-coloured or white. As it preserves its greenness all the year the thrift is frequently planted in gardens for a border, but requires to be renewed every two or three years. It blooms in July and August. Its flowers are a powerful diuretic. A second British species, *Armeria plantaginea*, distinguished by its leaves, which are three to five nerved, and broader towards the end, and by its purple flowers, is found only in Jersey.

THRI'NAX is a small genus of Fan Palms [see PALMS], natives of tropical America and the West Indies, of which about eight different species have been distinguished by botanists. They seldom exceed 10 feet in height, though some individuals reach 20, and they bear a crown of much cut fan-shaped leaves. In Jamaica they bear the name of Thatch-palms, from the particular use for which their broad leaves is excellently adapted. The tough leaf-stalks are also woven into baskets, while the cabbage, or head of undeveloped leaves, makes wholesome vegetable.

THRIPS is the common name for some peculiar insects belonging to the group Thysanoptera. The Thysanoptera is a small group, whose systematic position is uncertain, some classing it with the Orthoptera, others with the Hemiptera, while others again prefer to consider it as forming a separate order of insects. These insects have an elongated, narrow flattened, body and four slender wings, generally veinless, and fringed with long hairs. In some species the male is wingless. The legs are rather short, and the tarsi have two joints, the last one terminating in a bladder-like sucking joint. The antennæ are composed of eight or nine joints, and there are a pair of large eyes, between which are usually found three ocelli. The mouth is of a suctorial character. In some species the female is furnished with a curved boring ovipositor. The species are numerous, and are small insects found upon the leaves and flowers of plants and under the bark of trees. The metamorphosis is incomplete, the larvæ, which are active, closely resembling the perfect insects, and being found in the same situations. The species to which popular attention has been most drawn is the Corn Thrips (*Thrips cerealium*), because of the havoc it frequently commits on wheat and other cereals. The larva and pupa are only distinguishable from the imago or perfect insect by the

absence of wings. The larva is deep yellow, with the greater part of the head and two spots on the prothorax dusky. The antennæ and legs have alternate rings pale and dusky. The eyes are dusky red. The perfect insect is about three-fourths of a line long. Its appearance is smooth and shining. The male is destitute of wings. This species is found in the ears of corn, causing the grain to shrivel. It is most injurious to late-sown wheat. The same or an allied species is called the Black-fly by gardeners, from the destruction it causes in green-houses to cultivated plants.

THRO or **TARAU,** the native fiddle of Burma. Like our own ancient *rebeck* it has three strings. They are, however, of twisted silk. The tone is nasal, but is far superior in fulness and capacity for expression to the Chinese and other Oriental fiddles. Besides it is of much more advanced construction, possessing a soundboard with sound-post, sides cut into *échancrures* for the passage of the bow, as with our own violin, and what is most important, a fingerboard, though it is but a short one. Thros are generally beautifully ornamented with carvings and with inlaid ivory.

THRONES, an order of angels inhabiting the sphere of Saturn in the mediæval hierarchy. This is described under DIONYSIUS the Areopagite.

THROSTLE. See THRUSH.

THRUSH is a very common disease of children, especially those of the poorer classes, due to inflammation of the lining membrane of the mouth, which generally goes on to the production of ulcers, and these ulcers become coated with a kind of white mould caused by the presence of a fungus known as the *oidium albicans.* Usually the characteristic white flakes of this disease are found scattered over the tongue and the mucus of the mouth and lips, but occasionally they spread down the œsophagus and travel through the intestines. During the progress of the disease the white flakes are attended by local heat and tenderness, so that in severe cases a suckling child can hardly take the breast, the general health is deteriorated, there are signs of feverishness and drowsiness, and very often there is a good deal of diarrhœa. Thrush in infancy is usually due either to improper or insufficient food, giving rise to an acid state of the secretions of the mouth, and in its treatment attention must be directed particularly to this subject. Where a child is being nursed by its mother the inquiry must be directed towards her state of health, for the disease may arise and be sustained by a morbid condition of the milk. Where there is no reason to suspect this, and other circumstances will permit, the child should be kept entirely to the breast. If the child is fed by hand, the most careful attention must be paid not merely to the milk or artificial food used, but also to the cleanliness of the vessels in which it is kept, and of the bottles, stoppers, tubes, s m., &c., used in its administration. Where the diarrhœa is severe two tablespoonfuls of lime-water may be added to each half pint of milk; and if this proves insufficient to arrest the diarrhœa, a teaspoonful of the chalk mixture may be given three or four times a day. The child must be kept scrupulously clean, and its mouth must be washed after every meal, all particles of milk being removed by means of a camel's-hair brush. In cases of weakness caused by insufficient nourishment, two or three drops of brandy given in the food, four or five times a day has often a marked effect in checking the disease. For local treatment, a good application for the removal of the fungus is a solution of the sulphate of soda, or a little powdered alum may be dusted upon them, while a little of the *glycerinum boracis*, or a powder composed of borax and sugar, should be laid upon the tongue every hour or two.

Where thrush occurs in old people, or as an accompaniment of a wasting disease, attention must be paid towards the restoration and maintenance of the strength of the patient, while the microscopic fungus may be destroyed by washing the mouth with a weak solution of carbolic acid—one part of acid to sixty of water—or a solution of sulphurous (not *sulphuric*) acid, in the proportion of one part of the acid to six of water.

THRUSH (Turdidæ) is a family of birds of the order PASSERES, nearly allied to the SYLVIIDÆ or Warblers. The birds of this family have a bill of moderate length and thickness, with the upper mandible arched and keeled above, and finely notched or toothed near the tip on each side. The hinder part of the gape is bordered with a row of rather short bristles; and the nostrils, which are of considerable size and oblong in form, are placed on the sides of the base of the upper mandible, and partly covered by a membranous scale. The wings are generally well developed and rounded at the end, with the first quill very short. The tarsi are compressed, and usually clothed in front with a single scale. The tail is moderate.

These birds are distributed in all parts of the world. Their food consists partly of insects, worms, and terrestrial molluscs, and partly of fruits. Many of them possess great powers of song.

The Song Thrush, Throstle, or Mavis (*Turdus musicus*) is found throughout the year in Britain, though as a considerable migration takes place towards winter from the north and southwards, it is doubtful whether many birds actually spend the whole year in this country. On the continent of Europe the same partial migration takes place from the northern countries. It frequents wooded districts, orchards, gardens, and hedges. It feeds on snails, earthworms, insects and their larvæ, and seeds and berries of various kinds. In the winter snails form a great part of its food, the shells being broken upon a stone. At this season, too, it often repairs to rocky shores to feed on whelks and other molluscs, devouring their soft bodies after breaking the shells by knocking them against a stone or rock. Its flight is rapid, but most of its food is taken on the ground. The nest, which is built about the end of March or beginning of April, is usually placed in the centre of a thick bush or in a hedge at a short distance from the ground. It is cup-shaped, composed externally of slender twigs, roots, grass, and moss, and lined within with a thin layer of mud, cow-dung, or rotten wood. The eggs are generally five, sometimes four or six, of a bright bluish-green colour, with scattered brownish black spots chiefly at the larger end. Two broods are generally reared in the season. The thrush is one of the sweetest of our songsters. On the Continent these birds are snared in some places in great numbers at the autumn migration, as they are then very fat and well-flavoured.

The thrush is about 9 inches long. The general colour of its plumage above is olive-brown, the wing coverts being tipped with reddish-yellow; the cheeks, throat, breast, and flanks are yellowish, spotted with brownish-black; the belly is nearly white with a few spots of dark brown; the under wing-coverts are rich golden. The young birds of the year are marked all over the back with brownish streaks.

Other well-known British species of the genus Turdus are the MISSEL THRUSH (*Turdus viscivorus*), the REDWING (*Turdus iliacus*), the FIELDFARE (*Turdus pilaris*), the BLACKBIRD (*Turdus merula*), and the RING-OUZEL (*Turdus torquatus*), all of which are noticed elsewhere. In addition a few species occur in this country as stragglers from other regions. Several species occur in North America. One of the most common is the Red-breasted Thrush (*Turdus migratorius*), which is called the robin in the United States of America. This bird is about the size of our song thrush, and is of an ash colour above, with the head, wings, and tail black, the throat black, and the breast dark orange. This bird resides in immense flocks during the winter in the maritime states of the

Union, migrating in the spring to the higher regions of the interior. The nest is usually placed in an apple-tree, and is plastered in the inside with mud, like those of our British thrushes. The female lays five eggs of a delicate sea green colour. The Wood Thrush (*Turdus mustelinus*), another common American species, is found in the eastern United States. It resembles the song thrush in its coloration, and also in the sweetness of its song. It is very shy and solitary in its habits, being usually seen either singly or in pairs. The nest is placed in a bush, and contains four or five eggs of a uniform light blue.

The MOCKING BIRD (*Mimus polyglottus*) of America also belongs to this family.

THRUST, a miners' term for the bulging downwards of the roof in coal mines between the pillars that have been left as supports. This is produced by the pressure of the superincumbent rocks, when the floor is harder than the roof. When, however, the floor is more pliable, as ordinarily happens, the pressure results in its rising and the formation of rounded hillocks known as CREEPS.

THUA'NUS. See THOU, DE.

THU'BAN, the Arabic name of the star known astronomically as α Draconis; and a very nearly correct Pole-star in 2700 B.C. See the article and Plate POLE-STAR.

THUCYD'IDES (Gr. *Thoukudidês*) was a native of Attica. He was probably born in B.C. 471. The historian mentions incidentally a few facts concerning himself, which is almost all that we know with certainty about his life.

He was in Athens in the second year of the Peloponnesian War, B.C. 430, when he was one of those attacked by the plague. In B.C. 424 he held the command of an Athenian fleet of seven ships, which lay off Thasos. Brasidas, the Lacedæmonian commander, having made an attempt to obtain possession of Amphipolis, Thucydides sailed to protect it, but was only in time to save Eiôn, a seaport at the mouth of the Strumôn. Amphipolis had already fallen. For this he was either condemned to death or banished by the Athenians in the year following, B.C. 423; and he spent twenty years in exile. Marcellinus says that he first went to Ægina, and afterwards to Skaptê-Hulê in Thrace, opposite the island of Thasos, where he had valuable gold mines. It appears not improbable that he visited several places during his exile.

How long he lived after his return from banishment, and whether he continued at Athens till the time of his death, is uncertain. According to most accounts he was assassinated at Athens about 401 B.C.

The Peloponnesian War forms the subject of his great history. All men call it "great," though so great is its compression that it only occupies the space of an ordinary octavo volume. Though he was engaged in collecting materials during the whole of the war, he does not appear to have reduced them into the form of a history till after his return from exile, since he alludes in many parts of it to the conclusion of peace. He did not, however, live to complete it: the eighth book ends abruptly in the middle of the year B.C. 411, seven years before the termination of the war. Even the eighth book itself does not seem to have received the last revision of the author. The first two books of Xenophon's "Hellenica," which complete the history of the Peloponnesian War, were not improbably published by their author together with the eight books of Thucydides.

The first book is a kind of introduction, and the history of the war commences with the second. The object of the historian was to give such a faithful representation of the past as would serve as a guide for the future. His observation of human character was profound; he penetrates into the motives and policy of the leading actors, and he draws from the events he relates those lessons of political wisdom which have always made his work a favourite study with thoughtful men. Macaulay says distinctly "he is the greatest historian that ever lived," and repeatedly declared that there was no prose composition in the world which he ranked so high as his seventh book. Thucydides claims the merit of the strictest accuracy, and it is impossible to read his history without being convinced of the trustworthiness of his statements. His impartiality, also, is conspicuous. Although a contemporary, and one who had taken an active part in public affairs, he writes as free from party feeling as if he had lived long subsequent to the events which he narrates. He pays great attention to chronology. He divides each year into two portions, the summer and the winter, and is careful to relate under each the events that took place respectively during that time. The speeches which he introduces contain the general sense of what the speakers actually delivered, or might have delivered, although the language is his own.

His style is marked by great strength and energy; but he is often obscure. His sentences are often long, and the constructions harsh and involved. These remarks are more especially applicable to the speeches, which Cicero found as difficult to understand as we do. The reason for these defects is that Thucydides was creating a new art, had no models to guide him, and was obliged to stumble through every difficulty by his own sheer force of genius.

Among the modern editions, those most worthy of notice are Poppo's, which contains two volumes of prolegomena, with the scholia and numerous notes (Leipzig, ten vols. 8vo, 1821-51); and Dr. Arnold's, three vols. 8vo (Oxford, 1840), which is rich in elaborate and discriminative criticism.

The first English translation was made by Thomas Nicolls, from the French version of Seysel, and was published in London, 1550, folio. This was succeeded by the translations of Hobbes and William Smith. But all English translations were superseded in 1881 by the superb translation of Professor Jowett, a work equal, if that be possible, to his Plato, and owing to the difficulties of Thucydides produced under far greater disadvantages. The English reader for the first time is able to read this glorious history as it would have been written had Thucydides been an Englishman of the nineteenth century, while retaining all the peculiarities of thought and feeling of a Greek of the fifth century B.C.

THUGS (Hind. *thugna*, to deceive), a sect of assassins in India, now exterminated by the British government. They roamed about the country in bands of from 30 to 300, and strangled to death such persons as they could decoy into their company. These atrocious practices were not followed so much from impulses of plunder or malice as from religious motives. They were worshippers of the goddess Kali, who presided over impure love, sensual indulgence, and death. The members of the sect belonged to different Hindu castes, and each had its functions. The bands were under a *junadar* or *sirdar*, who was the leader, and a *guru* or teacher. Its members were classified into spies, who were learners; stranglers; entrappers, who were sometimes women; and grave-diggers. They usually assumed the dress of merchants or pilgrims, and often craved the protection of those whom they intended to destroy. Their usual instrument of destruction was the handkerchief, with which by a dexterous movement they strangled their victims. The spies having informed the band of the route, habits, and circumstances of their intended victims, the members travelled in such lines as to be near one another, and the entrappers by artful management attracted them to a spot remote from dwellings, where the stranglers executed their office; and having stripped them of whatever they possessed, the grave-diggers buried them with such precautions as generally to prevent discovery. The plunder was divided, one-third

to the widows and orphans of the sect, one-third to the goddess Kali, and the remainder to the partners in the assassination. After a murder the Thugs who had committed it united in a sort of sacrament, eating consecrated sugar. Their deities were carefully consulted before going on their expeditions, and unless the omens were favourable the Thug would not go. Neither women nor old men were victims. Europeans were never killed, as there would have been more danger of detection. There were also bands of Mohammedan Thugs, of the sect of Mooltanees, and it is possible that at first the system of *thuggee* originated with Mohammedan banditti, though it afterwards became more a Hindu than a Mohammedan practice, and the words used are of Sanskrit origin. Thugs were found in all parts of India. Attempts were made to exterminate these bands of murderers in several of the native states, even prior to the present century; but their connection as a widespread religious fraternity remained unknown till 1829, during the administration of Lord William Bentinck, who appointed Captain (afterward Sir William) Sleeman to break up the organization. This was successfully accomplished by the arrest of every known Thug, or relative of a Thug, in India; 3266 such persons were apprehended prior to 1837. They were colonized at Jubbulpore into a trade settlement, where technical instruction was afforded them and their children. Their descendants are still under government supervision there, and the practice of thuggee has become extinct. In 1836 the government published, for judicial purposes, "Ramaseeana, or a Vocabulary of the peculiar Language used by the Thugs," by Captain Sleeman. See also "The Confessions of a Thug," by Colonel Meadows Taylor (London, 1858).

THU'JA. See ARBOR VITÆ.

THU'JIN, a glucoside found in the leaves of *Thuja occidentalis* or *Arbor vitæ*, natural order Coniferæ. It crystallizes in lemon yellow four-sided tables, soluble in alcohol, and having the formula $C_{20}H_{22}O_{12}$; when heated with dilute hydrochloric acid it splits up into glucose and thujigenin ($C_{28}H_{24}O_{14}$); this substance is also found in minute quantity in the leaves of the plant. It crystallizes in microscopic needles, which are soluble in alcohol, but insoluble in water. Thujetin ($C_{28}H_{28}O_{16}$) is also formed by the action of acids on thujin. It is insoluble in water, but soluble in alcohol. This solution gives a brilliant green colour with ammonia. When boiled with baryta water it forms thujetic acid ($C_{28}H_{22}O_{13}$). It occurs in small yellow crystals, insoluble in water, but soluble in alcohol. The thuja leaves, when distilled, afford a light aromatic essential oil, called oil of thuja, which has been recommended as an external remedy for rheumatism and gout, as it has an irritating action on the skin; and it is also used internally for amenorrhœa, pulmonary catarrh, and as a vermifuge.

THU'LE, the name given by the ancients to the most northern country with which they were acquainted. This is generally believed to have been Iceland. Hence the Latin phrase *Ultima Thule.* The Greek navigator Putheas is the first who has left a record of Thulê, and he places it six days' sail from Britain. He actually visited it, and noticed that day and night were each six months long there. If it were not Iceland it was probably Norway. On the other hand, the Ultima Thule of Ptolemy was certainly the largest of the Shetlands. Modern writers use the phrase for the westernmost of the Hebrides, beyond the Lewis, as in Black's well-known novel "The Princess of Thule."

THUN, a town in the canton of Bern in Switzerland, picturesquely situated on the river Aar, about a mile below its egress from Lake Thun. Part of the town stands on an island formed by the river, and part is on the right bank, at the foot of a hill, on which is built the castle, the residence of the former counts of Thun. The parish church, with its lofty tower, is a remarkable building, and there is a magnificent view from the churchyard. There are also a handsome town-house, an hospital, an orphan asylum, a public library, and the central military school of the Swiss Confederation. The population is 5130. In summer the town is crowded with visitors passing to and from the Bernese Oberland. The Lake of Thun is 14 miles long, 3 broad at its greatest width, and about 700 feet deep. Its surface is 1780 feet above the sea. Steamboats ply on it daily. The shores near Thun are covered with villas and gardens: further east they are precipitous, and strikingly picturesque.

THUN'DER (Ger. *donner;* Lat. *tonitrus*, from the root *tono*, to thunder), a loud noise, which is heard after a discharge of lightning from the clouds. The character of the noise is variable; it sometimes resembles that which is produced when a single piece of ordnance is fired; at other times it is a rolling sound like the successive discharges of several great guns; and occasionally it may be compared to a series of sharp reports from a fire of musketry.

The physical cause of the detonation which accompanies a flash of lightning is the sudden and violent dilatation of the air along the track of the lightning flash, due to the resistance of the air and its consequent heating. The flash having passed, the air cools and contracts with great force, producing a sudden clap or explosion. If lightning is close to the observer one crash is heard, but otherwise the clap is echoed among the clouds, and arrives as a great rolling sound. Thunder is never heard at a greater distance than 14 miles from the flash, whereas the noise of artillery reaches much further, that at Waterloo having been heard, it is said, at the town of Creil, in the north of France, a distance of 115 miles. The flash of lightning and the report of the thunder take place in reality at the same moment; but since sound travels at the rate of 1100 feet per second, while the passage of light from the cloud to the observer may be considered as instantaneous, it follows that, on counting the number of seconds which elapse between the time of seeing the flash and hearing the report, the distance of the thunder-cloud from the observer may be ascertained if 1100 feet be multiplied by that number of seconds; or, roughly, five seconds to the mile.

Neither thunder nor lightning is known to take place beyond 75° N. lat.; even so low as 70° these phenomena are very rare. Captain Franklin, in 67½° N. lat. heard thunder on one day only between September, 1825, and August, 1826.

THUNDER-ROD. See LIGHTNING-CONDUCTOR.

THUR'GAU, a canton of Switzerland, bounded northeast by the Lake of Constance. Though intersected throughout by numerous chains of hills, the surface attains nowhere any great elevation, Mount Hörnli, the culminating point on the south frontier, rising only to the height of 2230 feet. It belongs entirely to the basin of the Rhine, which separates it on the north from Baden, the principal tributary being the Thur, from which the canton derives its name. This river, with its tributary the Murg, defines the two interior valleys of the canton, the third lowland, and the finest portion being that along the shores of Lake Constance. The soil is fertile, producing different sorts of grain, flax, potatoes, tobacco, hops, and immense quantities of fruit, particularly in the district near the lake. There are also many rich pastures, and abundance of excellent timber. Next to agriculture, the principal occupations consist in the manufacture of hempen, linen, and cotton cloth, and also of ribbons and hosiery. The capital is Frauenfeld. The canton has an area of 381 square miles, and a population of 99,552, of whom the majority are Protestants.

THURLES, a market-town of Ireland, in the county of Tipperary, 28 miles north by west from Clonmel, and 86 miles south-west of Dublin, by the Great Southern and Western Railway, stands on the west bank of the Suir, here

a small stream. The town contains a neat modern church, handsome Roman Catholic cathedral, well-attended Roman Catholic college, two nunneries, monastery, Baptist meeting-house, good market-house, sessions-house, barracks, branch banks, and dispensary. It has a good market, and supplies an extensive inland district, the immediate neighbourhood being rich, flat, and populous. Thurles is a place of very great antiquity, and contains the ruins of several ecclesiastical and castellated buildings. It is the residence of the Roman Catholic archbishop of Cashel; and in the college a synod, composed of all the Roman Catholic bishops of Ireland, was held in 1850, under the authority of the Holy See. The population in 1881 was 4850.

THU'RINGERWALD, or **THE THURING'IAN FOREST,** a mountain chain of Central Germany, extending 60 miles in a north-west direction from the Frankenwald, which unite it to the Fichtelgebirge, through the Saxon duchies. It is narrow at the north-west end, but widens out south-east to 20 miles. The highest summits are between Zella, Suhl, and Ilmenau; the Beerberg, 3230 feet; the Schnee-Kopf, 3220; Finsterberg, 3150; and the Kückelhahn, 2826; south-west of Gothia the Inselberg reaches 3005. Along the greater part of the crest of the range, 2500 to 3000 feet above the sea, runs the road called the Rennsteig (from *renn* = boundary), which is in part passable by carriages. The rocks in the north portion are chiefly porphyries; in the other parts, Cambrian, lower Silurian, and upper Devonian, supporting Carboniferous beds and Permian deposits on the flanks of the chain.

THURING'IA (Ger. *Thüringen*), the name given to that portion of the German Empire which is traversed in the west, from the north-west to the south-east, by the Thuringian mountains. The name is derived from a people called the *Thuringii*, who occupied the district in the fifth century. The Thüringian States (which lie almost entirely within the area inclosed by the kingdoms of Saxony and Bavaria, and the Prussian provinces of Hesse-Nassau and Saxony) include the grand duchy of Saxe-Weimar, the duchies of Saxe-Meiningen, Saxe Coburg-Gotha, and Saxe-Altenburg, and the principalities of Schwarzburg and Reuss.

THUR'LOW, EDWARD, LORD, an English statesman, was born in 1732, at Little Ashfield, near Stowmarket, in Suffolk. He was educated at the Canterbury grammar-school, from which he went to Caius College, Cambridge. His character and conduct at the university did not promise any eminence in future life. Soon after he quitted it he was entered as a member of the Society of the Inner Temple. In Michaelmas term, 1754, he was called to the bar, and went the Western Circuit. He soon obtained considerable practice, and in 1761 was made king's counsel. His practice in the courts rapidly increased, and during the ten years preceding his appointment as solicitor-general, was exceeded only by that of very few. In the new Parliament called in 1768 he was returned for the borough of Tamworth, and became a supporter of Lord North's administration. Upon Dunning's resignation of the office of solicitor-general in March, 1770, and Blackstone's refusal to accept it, Thurlow received the appointment, and in January, 1771, he succeeded Sir William De Grey as attorney-general. Soon after his introduction to office he attracted the notice of George III. by his zeal and energy in supporting the policy of Lord North's government respecting America, in which the king is known to have taken the warmest interest.

In the summer of 1778 Lord Chancellor Bathurst resigned his office; and on the 2nd of June in that year Thurlow was appointed his successor, and raised to the peerage with the title of Baron Thurlow of Ashfield, in the county of Suffolk. Four years afterwards, in March, 1782, when Lord North was removed from power, and the Rockingham administration was formed, Thurlow remained in possession of the great seal by the command of the king, and in spite of Fox's opposition. When this administration was dissolved in February, 1783, upon the coalition formed between Lord North and Fox, Thurlow was compelled to retire from office, notwithstanding the exertions of the king to retain him. Upon the dissolution of that ministry at the end of the same year in which it was formed, the great seal was restored to him by Pitt, who then became prime minister. He held the office for nine years after this reappointment, and until the occurrence of the king's madness, in 1788, appeared to act cordially with the rest of the cabinet; but when that event rendered a change of councils, by means of a regency, probable, he was suspected, with good reason, of some intriguing communications with the Prince of Wales and the Whigs, and was always subsequently regarded with distrust by Pitt and his colleagues. On the other hand Thurlow took no pains to conceal his dislike of Pitt. At last the premier told the king that either the lord chancellor or himself must retire from the administration. The king at once consented to the removal of Thurlow, who is said to have been deeply mortified. He died at Brighton on the 12th of September, 1806.

THURSDAY (Old-English, *Thunres-daeg*), the fifth day of the week, named after the Norse god THOR.

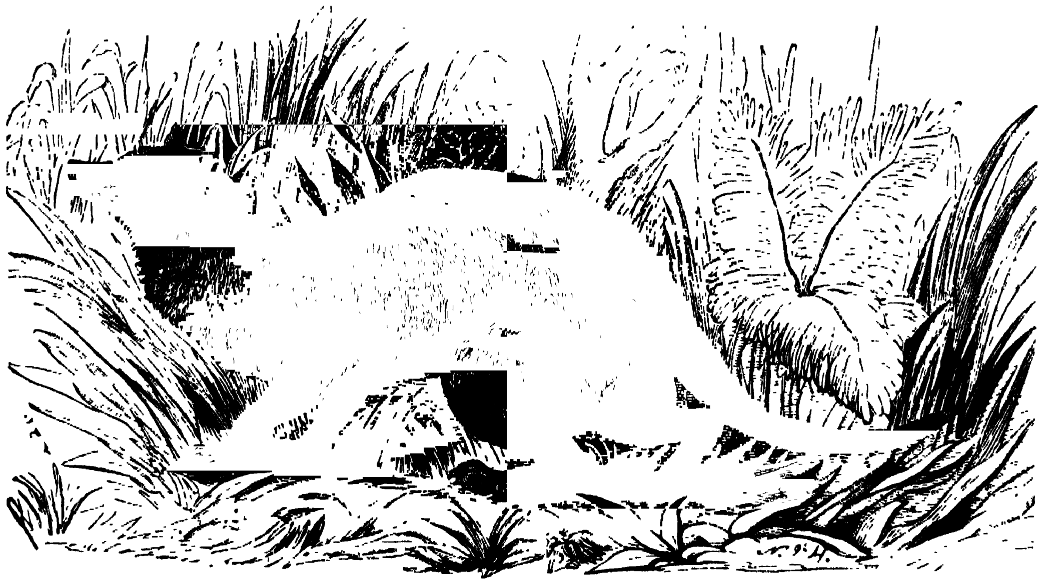
THURSDAY, HOLY, the day before Good Friday, often called in England MAUNDY THURSDAY.

THUR'SO, a burgh of barony and seaport of Scotland, in the county of Caithness, is situated on Thurso Bay, at the mouth of Thurso Water, 20 miles north-west of Wick, at the extremity of the Highland Railway, the furthest point in direct communication with the metropolis. It consists of old and new portions, and contains a town-hall, including library and museum, a parish church, the ruins of a fourteenth-century church, two Free Churches, Congregational Church, and an Original Secession Church. The foundation stone of the Dunbar Hospital was laid in 1882 by the Duke of Edinburgh. There are manufactures of woollens, netting, leather, and rope, and a thriving fishery is also carried on; besides which corn, cattle, sheep, and stone are extensively exported. Steamers ply regularly to Leith from Scrabster, on the west side of the bay, a short distance from the town, the harbour of Thurso being only capable of accommodating vessels drawing 12 feet of water. A little to the east is Thurso Castle, the seat of Sir George Sinclair, proprietor of the port. The sea views of Thurso are very grand. One of them includes the high rocks of Dunnet's Head, which are the Land's End of the north of Scotland. In 1881 the population of the town was 4086; of the parish, 6217.

THYES'TES (Gr. *Thuestês*), in the Greek mythology, was the son of Pelops, and brother of Atreus. The terrible fate of Thyestes is part of the woeful history of the house of Pelops. Atreus and he were banished by Pelops for the murder of their half brother. In their banishment they found fortune at Mycenæ, but Thyestes seduced his brother's wife and was banished from the city. He took with him the son of Atreus and bred him up as his own. Afterwards he sent him to kill Atreus, and the unhappy king slew his own son in defending himself. Discovering the crime he affected reconciliation with Thyestes and recalled him to Mycenæ. Killing the two sons of Thyestes he had their flesh served at a banquet to their father. This awful crime brought down the curse of the gods upon Atreus, and the fate of him and of his sons Agamemnon and Menelaos was most dismal. It is such ghastly tales as that of Thyestes which made the ancient philosophers revolt from so blood-stained a mythology, and in that revolt produced a Sokrates and a Plato, a Zeno and an Epicurus.

THYLACI'NUS (literally, "pouched dog") is a genus of MAMMALIA belonging to the order MARSUPIALIA and

family Dasyuridæ. The Dog-headed Thylacine (*Thylacinus cynocephalus*) is the tiger pouched wolf or zebra-wolf of the colonists. It is about 45 inches in length, and is the most predaceous of all the Australian quadrupeds. It is about the size and form of the wolf, a little lower on its legs. The body is covered with short, rather woolly, dusky-brown hair, the crupper being barred transversely with from twelve to fourteen black bands. The feet are semi-plantigrade, that is, half the sole of the foot is applied to the ground in walking. The head is dog-shaped, with a narrow elongated muzzle. The ears are short and erect; the tail is thick at the base, but tapers



Thylacinus cynocephalus.

to the point, and is about half the length of the body; the eyes are large, full, and black, and furnished with a nictitating membrane; the teeth are forty-six in number, and are arranged according to the following formula:—

$$i.\ \frac{4-4}{3-3};\ c.\ \frac{1-1}{1-1};\ p.m.\ \frac{3-3}{3-3};\ \ 4-4$$

The canine teeth are large and recurved at the top, those in the upper jaw being separated from the incisors by a space into which the lower canines fit. The feet are like those of a dog; the toes short and naked, very rough beneath, and armed with short, thick, compressed claws. The marsupial bones are represented by unossified cartilages. The marsupium of the female opens backwards. The zebra-wolf is nocturnal in its habits, and dwells in the caverns and among the rocks in the deep dark glens of the mountainous parts of Tasmania. It preys on kangaroos and other marsupials, and proves very destructive to flocks of sheep.

THYME (Thymus) is a genus of plants belonging to the order LABIATÆ. Between forty and fifty species have been described, most of them inhabitants of Europe, especially of the region of the Mediterranean; one only is a native of the British Isles. The species are low, much branched, spreading or decumbent shrubby herbs, with small entire leaves and flowers in dense terminal heads or loose spikes. The calyx and corolla are two-lipped, the upper lip of the latter being straight and nearly flat, while the lower is spreading and three-fid; the upper lip of the calyx is three-toothed, the lower two-fid; there are four diverging stamens, nearly equal, and longer than the corolla. The common or garden thyme is a native of the south of Europe, and has been for long cultivated in this country on account of its pungent aromatic odour and taste. These properties are communicated to water by infusion to a slight extent only. They depend upon an essential oil, an ounce of which may be obtained from 30 lbs. of the plant. The leaves, both in a fresh and dried state, are used for seasoning soups, stuffings, &c. The garden thyme yields a sort of camphor by distillation, and has been used in medicine, like the wild thyme, as a powerful stimulant. It grows to a height of 6 to 10 inches, and has narrow leaves and whitish or reddish flowers in whorls. The whole plant is covered with a hoary down. The Wild Thyme or Mother-of-Thyme (*Thymus serpyllum*) is a native of Great Britain, on hills and in dry pastures, and throughout temperate Europe and the north of Asia and Africa. It has a prostrate creeping stem, which produces erect leafy flowering shoots, ending in heads of whorled, purplish, or rose-coloured flowers; the leaves are narrow and oval, fringed towards the base and on the stalk. This plant has the same sensible properties as the last, but is more inclined to produce varieties, several of which have been described as species. These vary principally in the colour of the flowers and the size of the leaves and plant. One of the varieties is known by the name of lemon-thyme on account of its scent resembling the lemon. It is of lower growth than the garden thyme, the branches trailing on the ground and rooting at the nodes. It is in general cultivation on account of its fragrance.

THYMELÆA'CEÆ is an order of plants belonging to the group MONOCHLAMYDEÆ, series Daphnales. [See BOTANY.] This order consists of shrubs or small trees, rarely under-shrubs or herbs. Its species are found in Europe, but are not common; they occur in greatest abundance in the cooler parts of India and South America, at the Cape of Good Hope, and in Australia.

Their most prominent property is their causticity, which

resides in the bark. When applied to the skin it produces vesication, and pain in the mouth when chewed. The bark of several of the species is very tough, and may be manufactured into cordage. *Passerina tinctoria* yields a dye which is used in the south of Europe to colour wool yellow. The various species of DAPHNE possess active properties; some are used for dyeing, and some are poisonous. The Lace-bark Tree (*Lagetta lintearia*) of Jamaica belongs to this order.

The leaves are entire, without stipules. The flowers are usually sessile, in heads or spikes, or solitary; they are perfect, with a regular, tubular, usually coloured perianth, four or five lobed, bearing in its tube as many or twice as many stamens as the lobes, and a one-celled ovary with a short simple style and a single pendulous ovule.

THYM'OL or **THYMYL'IC HY'DRATE** is the stearoptene of the oil of thyme (*Thymus serpyllum*, natural order Labiatæ). It is isomeric with cymylic alcohol. It forms about one-half of the oil of thyme, from which it is separated by fractional distillation. It crystallizes in colourless rhomboidal plates, having the formula $C_{10}H_{14}O$. The odour is aromatic, but distinct from that of oil of thyme. The specific gravity is 1·0285. It melts at 44° C. (111° Fahr.) It boils at 230° C. (446° Fahr.) It is slightly soluble in water, very soluble in alcohol, ether, and acetic acid. Strong sulphuric acid converts it into thymyl sulphuric acid ($C_{10}H_{14}SO_4$). With bromine it forms pentabromothymol ($C_{10}H_9Br_5O$), a white solid. With chlorine it forms two compounds, trichlorothymol ($C_{10}H_{11}Cl_3O$), which crystallizes in yellow prisms, and pentachlorothymol ($C_{10}H_9Cl_5O$), which forms colourless crystals. When oxidized with sulphuric acid and peroxide of manganese thymol is converted into thymoil ($C_{12}H_{16}O_2$), which crystallizes in yellow scales. It is slightly soluble in water and alcohol, and quite soluble in ether. In contact with potash ley it is converted into thymoilic acid ($C_{48}H_{62}O_{10}$).

Thymol heated with sodium is converted into thymolic acid ($C_{11}H_{14}O_3$). It is obtained in silky crystals, which are insoluble in water. The crystals melt at 120° C. (248° Fahr.), and sublime unchanged at a higher temperature. Thymolic acid gives a deep blue colour with ferric chloride.

Thymene ($C_{10}H_{16}$) is the hydrocarbon forming the more soluble portion of oil of thyme. It is a colourless oil, having the odour of thyme. The specific gravity is 0·868. The boiling point is 160° C. (320° Fahr.)

Thymol is much employed in medicine as a powerful antiseptic, especially in surgical dressings. A weak solution is used as a disinfectant spray for the sick room. As an ointment, with vaseline, it prevents the bites of gnats and mosquitoes when applied to the skin. It is also useful in ringworm, being a most efficient germicide.

THY'MUS GLAND (in the calf and lamb called the Sweetbread) is an organ situated behind the sternum, in front of the large vessels arising from the base of the heart. In the infant it has, to the rest of the body, a very considerable size; in after-life it becomes comparatively smaller, and at last nearly disappears.

The thymus gland is composed of a great number of similar small masses or lobules, which may be separated by dissection, held together by fine cellular tissue, and varying in size from half a line to three lines in diameter. The fluid contained in the thymus gland is, in young and healthy animals, opaque and creamy.

THY'ROID GLAND (Gr. *thureos*, a shield, and *eidos*, like) is an organ situated in the middle and fore part of the neck, in front and by the sides of the thyroid cartilage of the larynx (from which it has its name), and of the cricoid cartilage and the upper part of the trachea [see LARYNX], to which it is closely fixed by cellular tissue. It is composed of two chief lateral portions or lobes, and a smaller portion or isthmus connecting them. A fourth portion, which is long and slender, and is named the middle column or horn, usually passes upwards from the isthmus in front of the larynx.

Of the function of the thyroid gland no more is known for certain than of those of the spleen and thymus gland, between which it seems, in structure, to hold an intermediate place, resembling the spleen in its vascularity, and the thymus in the existence of cells containing a fluid, and in its development during early life.

THYR'SUS (Gr. *Thursos*), the staff of the god Dionusos or Bacchus, terminated by a pine-cone (turpentine was used in making wine in those times, and still occasionally is in Greece); or by a bunch of ivy, or of vine leaves and paper, arranged in a conical shape. The god concealed a spear point beneath these leaves, and the prick of his spear produced the Bacchic frenzy.

THYSAN'URA is an order of INSECTS forming the lowest group of that class. The Thysanura present such marks of low organization that by some they are separated altogether from the class Insecta. There appear good reasons to regard them as the surviving and modified representatives of the primitive group from which the whole of the insect class sprang. The Thysanura are wingless, and undergo no metamorphosis. The organs of the mouth are in a rudimentary condition, and generally concealed within the cavity of the head. True compound eyes occur only in one genus. The body is soft, and covered with hairs or scales. In addition to the three pairs of thoracic feet the lower surface and tip of the abdomen are generally furnished with appendages, serving in most cases as leaping organs. The order is divided by Sir J. Lubbock into two groups, Thysanura or Bristle-tails, and Collembola or Spring-tails.

The Bristle-tails are brilliant silvery little insects, covered with minute metallic scales, which are used as delicate tests for the microscope. he abdomen consists of ten segments, and terminates in long bristle like appendages; in addition its under surface is furnished with paired movable appendages or stiff hairs. The abdomen of the females is furnished with an ovipositor. The prothorax is large, and the tarsi are from two to four-jointed. The antennæ are long, and composed of many joints. The structure of the organs of the mouth approaches that of the Orthoptera, the mandibles and maxillæ being more or less exposed, and the latter being furnished with palpi, which are sometimes five or seven jointed; the labial palpi are four-jointed. The species are rather numerous, and are found in dry warm places. *Lepisma saccharina* is frequently found in this country in sugar, among the dust of houses, and also in decaying wood. *Machilis maritima* is common on rocks and under stones on our coasts. It is about half an inch long, mottled-brown in colour, with springing abdominal appendages and compound eyes. *Campodea staphylinus* is a small eyeless species found in damp ground.

The Spring-tails, forming the group Collembola or family Podurida, are distinguished by having the antennæ short, four to six-jointed, the mouth-organs rudimentary without distinct palpi and sometimes suctorial, the prothorax small, and the tarsi consisting of a single joint; the tip of the abdomen is furnished with a pair of appendages which form leaping organs, and are bent forward in repose so as to reach nearly to the head. The body is covered with hairs or scales. The abdomen consists of six distinct segments, on the ventral surface of the anterior of which is placed a sucker containing a viscid fluid, by means of which the insect can adhere to smooth surfaces. The species are small, long, soft insects, found in damp places and on the surface of pools. *Orchesella*

cincta, about a quarter of an inch long, is found under decaying leaves, in moss, &c., in Britain. *Podura aquatica*, another British species, is met with leaping about on the surface of ponds, &c.

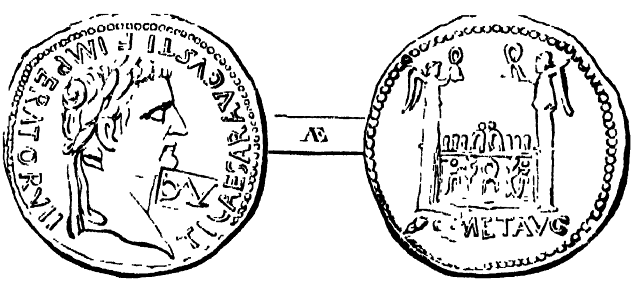
TIAR'A, an ornament for the head, worn in ancient times by the inhabitants of Middle and Western Asia, especially by the Persians, Parthians, Armenians, and Phrygians. There were two kinds—the upright tiara was used by kings, priests, and other persons of the highest rank, and the upper part had frequently the shape of a crown; the tiara worn by the lower orders was of a soft and flexible material, so that it hung down on one side, as in the case of the so-called Phrygian bonnet. In modern times the term is applied to the head-dress of the popes, which is worn on solemn occasions, and consists of a triple crown. The first crown was added by Nicholas I., the second by Pope Boniface (1300), and the third by Urban V. (1365). The peculiar form of the pope's tiara has led some archæologists to trace its origin back to pagan antiquity; for triple crowns bearing a marked resemblance to it were worn by the Assyrian kings, as represented on the slabs found at Nineveh by Botta and Layard.

TI'BER (in Italian *Tevere*), a river of Italy, rising in the Tuscan Apennines, near the source of the Arno, east of Florence, and flowing S.S.E., W. and S.W. past Rome to the Mediterranean, 17 miles below that city. Bifurcating 4 miles from the sea, it enters by two mouths, inclosing the wooded and swampy island of Isola Sacra; the first is the Ostia mouth, the second is the Fiumicino, and has been since Trajan's time the port of Rome, and the principal port of entrance. Within the city the river is 150 yards wide, and its clayey valley colours its waters yellowish-white. It is connected with the Arno by means of the Chiana and a canal, and has a course of 240 miles. See also ROME.

TIBE'RIAS, LAKE OF, also called *Sea of Chinnereth* and *Galilee*, and *Lake of Gennesareth*, is an expansion of the Jordan in Palestine, famous in Scripture history. It is 328 feet below the level of the Mediterranean; extends from 12 to 15 miles in length, by from 6 to 9 in breadth, and has a mountainous shore, on which stood the cities of Capernaum, Bethsaida, and Chorazin, whose sites can scarcely be identified, while their names have entirely perished in the district. The expanse is a very lovely one. It abounds with fish, and is subject to sudden changes from calm to disturbance, owing to the strong gusts of wind which rush at intervals through the gorges of the mountains. Fishing is now entirely conducted by casting the net from the shore. No boat or sail appears upon the surface, except at very rare intervals, when some enterprising traveller from the West makes the venture, and provides the conveyance. The feathered tribes are numerously represented in water-fowl, birds of prey, and small warblers. But hours may be passed without seeing a human being upon the strand once occupied by flourishing towns.

TIBE'RIUS (TIBERIUS CLAUDIUS NERO CÆSAR), Emperor of Rome A.D. 14 to 37, and perhaps the most maligned man in all history, was born in Rome, 16th November, B.C. 42. He belonged to the Claudian gens by the side of his father, Tiberius Claudius Nero, as well as by his mother Livia Drusilla, who was the niece of her husband, and was afterwards espoused by Augustus. The elder Tiberius of course divorced his wife before the emperor married her: he died shortly afterwards, B.C. 38. Thus Tiberius the younger and his brother Nero Claudius Drusus became stepsons of Augustus. (Tiberius was four years old, Drusus was born after the marriage.)

Tiberius married Vipsania Agrippina, the daughter of Agrippa, and the granddaughter of Cicero's friend. T. Pomponius Atticus. She brought him a son, Drusus, and she was again with child when he was obliged to sacrifice her to the policy of Augustus, who compelled him to marry his daughter Julia, the widow of Marcellus and of Agrippa, and the mother of Caius and Lucius Cæsar (12 B.C.) The reason was that Augustus wisely desired to settle the state. His chosen successor, his nephew and son-in law Marcellus, had died; his bosom friend and second son-in-law Agrippa, had died also; his third choice fell upon his grandsons, but they were children, and the emperor's health was at this time feeble (it grew stronger later on), therefore he desired his stepson Tiberius to become a father to the princes and to reign as his immediate successor. Tiberius was a grave silent man, austere, very handsome (as we know from his numerous busts), a thorough soldier, and the adored commander of his troops; and above all things an admirer of the old simple republican manners. Julia had previously made advances to the handsome severe young prince, which he had repelled with disgust. Everyone in Rome but Augustus knew the worthlessness of the abandoned woman, still only twenty-eight, though twice a widow. Pliny says that though Tiberius obeyed, and



Coin of the Emperor Tiberius.

divorced his quiet and gentle Vipsania, he became the saddest of men (*tristissimus hominum*). Once, and once only, did he see again his Vipsania. He met her by chance, and as she parted from him he gazed after her with such strained and bursting eyes (*adeo contentis et tumentibus oculis*) that good care was taken he should never see her again. This is a different man from the monster Tacitus has chosen to create for us. Tiberius had a son by Julia, but her scandalous conduct soon disgusted him, and he withdrew from all intimate intercourse with her.

During this time Tiberius was twice intrusted with the "cura annonæ," or the superintendence of the supply of corn to Rome. He made his first campaign as tribunus militum in the Spanish war against the Cantabri. He afterwards restored Tigranes to the Armenian throne, and compelled the Parthians to restore the Roman eagles which they had captured from M. Crassus, in B.C. 63. In 15 B.C. he and his brother Drusus had subdued the Alpine Rhæti; and Tiberius also terminated the war in Pannonia, which had lasted since B.C. 18. In B.C. 13 he was consul with P. Quintilius Varus. His brother, who was carrying on the war in Germany, died B.C. 9, in consequence of a fall from his horse. Tiberius, who was then in North Italy, hastened to the camp of Drusus on hearing of the accident, and arrived there just before he died. He was tenderly attached to Drusus, and had ridden night and day, accompanied by one guide only, that he might see him for a few moments before he died. He brought his brother's dead body to Rome from Mainz, walking before it the whole distance, in the depth of winter too—again a remarkable thing for a depraved sensualist to do voluntarily. Tiberius was successful in his contests and his negotiations with the Germans. He gave up the command

in B.C. 7, and returned to Rome to enjoy a triumph. In this year he was also consul for the second time.

In the midst of this prosperous career Tiberius left Rome and retired, B.C. 6, to the island of Rhodes, where he lived in retirement for eight years. Augustus had lived longer than he had hoped; his grandsons were now young men. He repented his having led Tiberius to be regarded as his heir, and kept him studiously employed away from Rome lest his known integrity and virtue might raise a party in his favour. At last Tiberius saw through the emperor's design, and very naturally resented it. He openly desired leave to retire from public service. Augustus appointed him to Armenia to conduct a frontier war, failing which he forbade him to leave Rome. Tiberius determined to starve himself to death, and had already gone four days without food when Augustus relented, and suffered him to depart. A crowd of admirers followed him to his ship. He silently kissed one or two, but said not one word, lest he should compromise his friends. Again we fail to recognize the monster of Tacitus in this proud and affectionate man.

Tiberius lived very simply at Rhodes, but attended to the government of the place with his usual military precision. All through life he was accustomed to write down every evening what he meant to do the next day. The attendants finding a memorandum to visit the sick on the coming day thought to find favour with the prince by bringing all the sick to his door to save him trouble. When he found the long lines of litters along the market-place, Tiberius stood for some moments in embarrassment; but at length went round and begged the pardon of each patient separately, however humble. This remarkable trait must be true, for it is told by the virulent Suetonius.

At last, having made it clear that he was a private citizen, and above all, finding that Julia had been found out by her father and banished from Rome, Tiberius wished to return. But Augustus freezingly refused him. At this time, from the jealousy of young Caius, then commanding in the East, Tiberius was certainly in danger of his life. The adherents of the young prince openly offered to assassinate Tiberius. This coming to the Empress Livia's ears, she used her vast influence with her husband to allow her son to return. Tiberius returned to Rome A.D. 2. In the same year young Lucius Cæsar died at Massilia (Marseilles), and his death was followed by that of his brother, A.D. 4. Augustus then once again named Tiberius as his future successor, formally adopting him as his son, so that he took the name of Cæsar in addition to his own, and Tiberius in his turn was compelled to adopt Drusus Germanicus, the son of his late brother Drusus. Tiberius had also a son of his own named Drusus. The imperial throne was thus secured to the house of the Claudii. In the same year (A.D. 4) Tiberius was appointed commander-in-chief in Germany, and he was accompanied by the historian Velleius Paterculus, who gives a very favourable idea of his talents as a general, and of his conduct in the German wars.

The character Tiberius bore with his soldiers was akin to that of Napoleon. They believed in him most thoroughly; and with reason, for, like our own Wellington, he never lost a battle. When, after ten years' absence, he returned to the army of the Rhine, the veterans actually wept for joy. "Do we see you once again, general?" "Are you safe with us once more?" "I served with you in Armenia, general." "You decorated me in Bavaria, general." "And me in Pannonia." "And me in Germany." The little scene, as told by an eye-witness, is quite dramatic and touching (Velleius ii. 104). Tiberius had a litter as usual, but he gave it up to the wounded, and the same with his tent. He was fifty-three when he fought his last campaign thus, riding at the head of his troops and bivouacking in the open. Wherever he could find them he beat the Germans; but their irregular savage life made them indomitable: they only appeared in small parties, and the Romans, while everywhere victors, were in reality vanquished.

Augustus died at Nola on his return from Naples, where he had accompanied Tiberius, who was appointed to conduct the war in Illyricum (on the 29th of August, A.D. 14). Livia concealed the emperor's death until her son, who was informed of it by messengers, had arrived at Nola. Tiberius did not, however, take office till pressed to do so by the Senate. The empire was known by all to be a necessity, and it was equally clear that Tiberius was the proper man as emperor. For some years he had been practically at the head of affairs.

At the age of nearly fifty-six, with "an exemplary life and a deservedly high reputation," as his maligner Tacitus admits, Tiberius became emperor.

Immediately upon his accession Agrippa Postumus was put to death by orders left by Augustus. This man was an execrable brute, with all the vices of his mother Julia, and none of the virtues of his father Agrippa, and his grandfather had long resolved he should never become a source of danger to the state. About this time the supreme power was offered by the troops on the Lower Rhine to Germanicus, who, however, refused it; and the mutiny was quelled by him and by Drusus, the son of Tiberius, who commanded in Pannonia. As soon as Germanicus, the favourite of the army, had avenged the defeat of Varus, Tiberius recalled him from Germany, and sent him into the East (A.D. 17). There he conquered Cilicia and Commagênê, and renewed the alliance with the Parthians; but he died suddenly at Antioch (A.D. 19).

The death of Germanicus, between whom and his adopted father perfect loyalty seems to have reigned, left Tiberius much alone. His own son, Drusus, was indolent, and the extreme jealousy of the aristocracy, whose constant plots against his life became intensely irritating, put it out of the question to raise one of them to the ministry in any special way. In these circumstances the emperor trusted greatly to a very clever freedman (son of a slave) named Sejanus. While Tiberius was at the head, with this man as his prime minister, affairs seem to have been marvellously administered. The provinces, harassed most cruelly under the republic, had already benefited by the rule of Augustus; but their gratitude to Tiberius was such that the cities of Asia voted a temple to his honour, and Josephus and Philo Judæus describe his reign as a "blessed era, recalling the Saturnian age of the poets." Only one prosecution in all his twelve years at Rome did Tiberius allow to proceed to actual execution of the culprit; but he was very severe upon oppressors of the provinces who sought to revive the "good old times" of plunder. His alleged "destruction of liberty," by the abolition of the comitia and the assumption of the power to appoint the great officers of state, and the large employment of secret police, which are charged against him by the old-fashioned school of historians, blind followers of Tacitus, were really necessities of the time. The senatorial government was a sink of tyranny and corruption, and it needed a strong, stern ruler such as Tiberius to prevent the world from falling into chaos. The nobles continued to squander their wealth; Tiberius lived in the simplest way, reserving his money for magnificent gifts out of his private fortune whenever succour was required, for instance, after a fire at Rome, &c. No slave worked harder or fared more frugally than Tiberius. Even in the sultry autumn he could not leave Rome. After twelve years of this life, he being now sixty-eight years old, an allusion was made to his private life during a trial over which he presided. To his horror he found that he who had made himself unpopular by his reserved austere life, and who was all his life far too carelessly proud to win the personal affection of the people at large, which he could easily have had just as well as he had that of his army, was accused of foul licentiousness in the gossip of Rome

He had said proudly, alluding to his unpopularity, *Oderint dum probent* (Let them, the nobles, hate me, so long as they respect me), but now he was stung to the quick. He sprang to his feet and passionately demanded to have these libels examined, nor could his friends calm him without difficulty. Afterwards his ordinary proud indifference returned and he ostentatiously held himself aloof from noticing these charges. He was now disgusted with Rome, and as plots against his life were incessant, he withdrew, A.D. 26, to Capreæ (modern Capri), an island in the bay of Naples, accessible only by two landing-places, while close to the shore of Italy and affording means of reaching his favourite army of the Rhine in case of an outbreak. Here from the age of sixty-eight to that of seventy-eight the old man ruled the world; with what success may be best measured by seeing the result as soon as his wise hand was withdrawn from the helm.

Tiberius away, Sejanus was mad enough to aim at the throne. He is believed to have induced the wife of Drusus, the son of Tiberius, who was his mistress, to destroy her husband. Agrippina (widow of Germanicus) and her eldest son were deep in plots, and Sejanus denounced them. Tiberius sent them to prison (A.D. 29), where both of them died. Agrippina had openly denounced Tiberius as the murderer of her husband, but in his lofty way he had taken no notice of her scolding. Actual plots were another matter. Sejanus next denounced Drusus, the second son of Agrippina, and his treason being only too clear, he was condemned to death by the Senate A.D. 30. He died in prison A.D. 33. Sejanus thought that his course was clear and began active measures. Tiberius learned this, and wrote to the Senate to see to it. The Senate had the tyrannical minister arrested at once, and he was rapidly tried and condemned. The people were mad with delight, and hauled the body about the streets (A.D. 31).

Meanwhile this old man of seventy in his secluded island is said to have spent his time in sheer bestiality and license. The pages of Suetonius and Tacitus are too filthy to read with pleasure. Two things are to be remarked. First, though many profligates become austere when the fire of youth has abated, a man of austere life does not turn profligate at seventy; or if he does he kills himself. Even a young man would have perished of such excesses as are told us. Secondly, the emperor after losing Sejanus had everything on his hands, for young Caius (Caligula), the surviving son of Agrippina, was a foolish prince. Such a man can have really no time for filthiness. The lewd imagination of a dissipated and envious aristocracy invented this absurd defamation of their prince to avenge themselves on his contemptuous seclusion. It is a pity Tiberius so scornfully neglected to clear himself of charges which we know he was aware of.

On the 16th of March, A.D. 37, while at the villa of Lucullus in Misenum, Tiberius fell into a lethargy, and everybody believing him to be dead, Caius, the third son of Germanicus, was proclaimed emperor. However, Tiberius opened his eyes again, whereupon the prefect of the guards, Macro, in order to save himself and the new emperor, ordered him to be suffocated in his bed. He died at the age of seventy-eight, after a reign of twenty-three years. (Tacitus, "Annales;" Suetonius, "Tiberius.")

TIB'ET or **THIBET** (Tibetan, *Bod yul*, "Land of the Bod"), is the most southern of the three great table-lands of Middle Asia. It is bounded on the W. by Independent Turkistan; on the S.W. and S. by the Punjab, Hindustan, Nepaul, Bhotan, and Assam; on the S.E. by Assam and China; on the E. by China; and on the N. by the desert of Gobi and Chinese Turkistan. The northern part of Tibet is very little known, but the area of the whole country is generally believed to be from 600,000 to 800,000 square miles, and the population is estimated at about 6,000,000.

Tibet is a table-land, the highest plains of which are more than 15,000 feet above the level of the sea, and the average from 10,000 to 12,000. This is, therefore, the most elevated inhabited country on the surface of the globe. It is almost entirely surrounded by mountains, which generally present abrupt slopes. The elevated roads by which the country is entered from India pass through deep ravines cut by the streams, and present scenes of the wildest grandeur. The table-land of Tibet is divided into three great and distinct parts. The first, which is long, and not very wide, begins in the east, near Mount Kailasa, in the Himalayas, and stretches to the north-west, between parts of the Himalayas and of the Hindu-Kush in the south-west, and the range of the mountains of Karakorum in the north-east. It is traversed in its whole length by the upper part of the Indus. Its lower or north-western part, Balti or Baltistan, is also called the First Tibet or Little Tibet, and is an independent state. Its upper or south-eastern part has the name of Ladakh, and is also called the Second Tibet, or Great Tibet, because it is larger than Baltistan. Sometimes the name of Little Tibet is given to the whole valley of the Indus. Ladakh is also an independent state, but the most eastern part of it, as far as Teshigang on the Indus, belongs to China. The second great division of Tibet begins in the south, near Mount Kailasa, and is an immense elevated desert, the western part of which is called Khor and the eastern Katchi. The third great division of the country contains the districts which lie east and south of Khor and Katchi. The second and third natural divisions have the common name of Eastern Tibet, or Tibet Proper, and are subject to China. They are traversed by numerous ranges of lofty mountains, the direction of which is from west to east and from north-west to south-east. From these ranges lateral branches run out in different directions, and contain deep valleys between them. In proportion as the principal chains advance towards the south-east they converge towards one another, and thus the valleys between them gradually become narrower, until at last, on the frontiers of Yunnan and Burma, they are mere mountain passes.

The chief river is the Dzangbo, which flows in an E.S.E. direction through the whole of Southern Tibet, a distance of about 700 miles. It has many large tributaries. Two other great rivers are the Gakbo-Dzangbo-tsu and the Om-tsu. The Lang-tsang-Kiang traverses almost the whole extent of Eastern Tibet, from north-west to south-east, and flows into the Chinese Sea in 10° N. lat., after a course of more than 1700 miles. The sources of the Kincha Kiang, or Yang-tse-Kiang, which traverses China from west to east, are situated between 37° and 38° N. lat., and between 89° and 92° E. lon., on the table-land towards the north-western frontiers of Eastern Tibet. The Ya-long-Kiang is an important tributary of the Kincha-Kiang. The Sutlej, Brahmaputra, Irawaddy, Salwin, Menam, Me-kong, and several affluents of the Ganges, also rise within the boundaries of Tibet.

The Tengri-Nor, the largest lake, is surrounded by high mountains and rocks covered with snow and ice. The Lake of Palte resembles a large ditch surrounding an extensive island which fills up the middle of it. In the extreme north of Tibet is situated the Khu-Khu-Nor, or Köke-Nor, that is, "the Blue or the Celestial Lake," which name has been given to all the surrounding country. Most of the lakes are salt or brackish, and several of them are regarded with religious veneration, attracting pilgrims from afar to their shores.

Tibet is known in India and China as a country of hunger and misery; but however cold and barren the table-lands and the mountains may be, on account of their extreme elevation, and of the snow which perpetually covers whole tracts, the climate of the valleys, and especially that of Dzangbo, is hot. The air is excessively dry, and its effects resemble those of the dry heat of the Sahara.

Among the minerals are gold, silver, copper, and tin. Salt is taken from the lakes of Jayek and Deng tsavga: and corundum stone, lapis-lazuli, turquoise, and agate are found. Besides a great number of grasses which are common in Europe, Tibet produces a kind of barley, and grapes, asafœtida, rhubarb, madder, safflower, apples, nuts, apricots, peaches, pomegranates, and figs in the valleys. Little wheat, and even less rice, is grown. Black barley forms the basis of all Tibetan diet. The cedar and birch thrive; but except in some of the valleys, wood of all kinds is very scarce; and argol, or the dung of animals, pounded and mixed with earth, is the fuel chiefly used. With this even metals are smelted. Among the animals are wild oxen with long hair, buffaloes, the grunting ox called the *yak*, goats with a very fine fleece, others with long fine hair used in the manufacture of the celebrated Cashmere shawls, sheep, silkworms, wild cats, bears, tigers, leopards, lynxes, musk-deer, pigs, white eagles, and swans. All European domestic animals are known in Tibet, and the horses are excellent. The inhabitants of the capital are good goldsmiths, and excel in the art of sculpture. Their idols are full of expression, and wherever the grotesque and colossal form is not required by the tenets of their creed, the Tibetans imitate nature very well. They also make various fabrics of goat's hair and wool, but their woollen manufactures resemble felt more than European cloth. They are in demand in China, and have even been introduced into India. The velvet made is celebrated for beauty of colour. In dyeing the people excel; there is a peculiar gloss and freshness in their tints. Their rosaries are exquisitely made; the stones are taken from the sacred river near Lassa, and are beautifully cut. Coral, cornelians, &c., imported from India, are cut, and then sent back again. The chief town of Tibet is LASSA.

The first accounts of the history of Tibet occur in the annals of the Mongols and Chinese. The Tibetans belong to the former race: they were at first divided into many independent tribes, which led a nomadic life, but were united to form a kingdom about 313 B.C. Buddhism was introduced in 407. Lassa was built about 650 by Srongdsan-Gambo, who seems to have been the most famous of the Tibetan kings.

Since the year 1720 all Tibet has been a vassal state of China. Chinese garrisons are in its towns, and they watch the passes in the frontier mountains. In the early part of the present century, Western Tibet was conquered by the Sikhs, under Runjeet Singh, and now forms part of the territory under British supervision known as Gholab Singh's dominion. The national government of Tibet is supported by a perfectly organized hierarchy. The name of the chief priests is Lama; and the Dalai-Lama is the first of them; the second is the Toshu, or Bogdo Lama. The people are kind, tolerant, polite, and much more civilized than the Mongols, although they are generally poor. They practise polyandry. Arts and literature are cultivated, but the works and the language of the Tibetans are not much known in Europe. Both the Lamas are absolute princes in religious matters, but their sovereignty is checked by the authority of the Emperor of China.

Tibet has always offered a tempting market for Indian trade, and an attempt to open the country was made by Boyle, an official in the East India Company, in 1774, by orders of Warren Hastings, but the recall of the latter and the death of the Lama brought it to nothing. In 1886 another expedition—which the Chinese government cordially approved of, and which the Tibetan authorities at Lassa were ready to receive—started from India under the leadership of Mr. Colman Macaulay, but, for some reasons which have never been fully explained, was recalled by the home authorities. It is, however, still hoped that further measures may be taken to promote the trade between the two countries.

TIBUL'LUS, ALBIUS (of uncertain prænomen), was born in Italy about 54 B.C. Belonging to an equestrian family, he inherited an estate near Præneste; but his property, like that of Virgil, was confiscated during the civil wars. He succeeded, however, in recovering a part of it, as we learn from one of his most pleasing elegies. The literary talents of Tibullus obtained for him at an early age the favour of the great; and in 31 B.C. he accompanied his patron Messala into Gaul, where he shared the fatigues of a campaign in Aquitaine. Military life seems, however, to have been very little in accordance with his tastes, and on the conclusion of the war he returned to Italy. Very few particulars are mentioned of his subsequent life; but it is known that he died young, probably about B.C. 18. Tibullus was an amiable and accomplished man, and very popular with his contemporaries. Both by Horace and Ovid he is addressed in terms of high regard and esteem. His works are universally ranked in the first class of elegiac poetry; nor, perhaps, has any writer ever surpassed him in polished elegance or graceful tenderness. His morality was that of his age and country—his literary merits were his own. The two first books of the "Elegies" can alone be considered indisputably genuine; the third is certainly spurious, and the authenticity of the fourth is doubtful. The best editions are by Lachmann (Berlin, 1829), and by Dissen (Göttingen, 1835); English translations by Dart (1720) and Grainger (1759).

TI'BUR, the modern *Tivoli*, was one of the most ancient Latin towns, and lay only 16 miles to the north-east of Rome, upon the Anio, close by a grand waterfall made by the river. It fell to Rome after a long contest, B.C. 338, and soon became a favourite retreat for wealthy Romans. Horace had his favourite country house at Tibur. The Emperor Hadrian built an enormous "villa" here, whose vast ruins have yielded countless treasures of ancient art. Zenobia, queen of Palmyra, resided here after her fall. The sacred grove and oracle of the Sibyl Albunea was in the immediate vicinity of Tibur.

TICAL, a Chinese weight of about $4\frac{1}{2}$ oz.; and also a money of account, estimated at about the third of a pound sterling. Among the Siamese the tical weight and coin is 236 grains troy, and its valve in the currency about 2*s.* 6*d.* The tical of Burma is worth about 2*s.*

TICI'NO (*Tessin*), a Swiss canton situated on the Italian slope of the Alps. It is throughout mountainous, being bordered on the north by the principal ridge of the Alps, and intersected everywhere by their numerous ramifications. The largest rivers are the Ticino, flowing through a wide vale into which other valleys in the canton open, and the Maggia, in a fine open valley. The scenery and climate vary considerably in different parts of the canton, and the contrasts are remarkable. The soil in the valleys is in general very fertile, and the mountain sides are clothed with rich pastures, and often with extensive forests. The chief branches of industry are agriculture and the rearing of cattle, particularly the latter. Ticino was first formally admitted to the Swiss Confederation in 1815. The Italian language is spoken generally.

The population of Ticino, which is entirely Catholic, amounted in 1880 to 130,777. The area is 1033 square miles.

TICK is the common name applied to many species of ACARIDEA, an order of Arachnida. The true ticks, forming the family Ixodidæ, are found in most parts of the world, although they are most abundant in the tropics. Some of the tropical species are the largest of all the Acaridea, attaining a length of over one-fourth of an inch. The body is roundish and is covered with a thick leathery or partly horny skin, which is very extensible. The mouth is suctorial, and the chelicera, which are retractile and serrated, act as piercing organs. There are four pairs of simple legs, terminated by two claws. The ticks are para-

sitic on mammals, birds, and reptiles, of which they suck the blood. Most of them live in woods, forests, fields, &c., being found on the herbage and attaching themselves to passing animals. Where they are numerous they often do great destruction to cattle and horses, and a few species attack man. The Dog Tick (*Ixodes erinaceus*) is common in Britain, attaching itself to dogs, oxen, hedgehogs, and sometimes to man. It is about the size of a grain of linseed, which it resembles in form; but it swells to many times its original size when engaged in feeding on its host, and the wounds which it makes are attended with much inflammation and pain. The Persian Tick (*Argas persicus*), a native of Persia, sucks the blood of man, causing serious results by its attacks. An allied species to this is the TAMPAN, described by Livingstone, who suffered from it in Africa. The tick of domestic poultry and pigeons is *Dermanyssus avium*, which also attacks cage birds. It belongs to a distinct family, Gamasidæ.

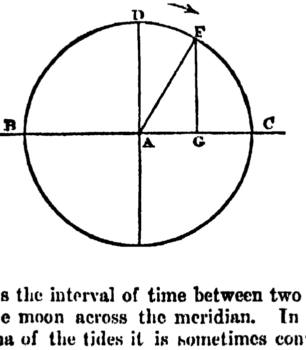
TICK'ELL, THOMAS, one of the minor English poets, was born in 1686, at Bridekirk in Cumberland, his father being a clergyman. He was educated at Queen's College, Oxford. For his success in life he was largely indebted to Addison, whose favourable notice he secured by some well written lines on Addison's opera of "Rosamond." The gentleness of feeling and elegance of taste which are perceptible in all Tickell's best productions would also be recommendations to the goodwill of the kind-hearted *Spectator*. His translation of the first book of the Iliad, which has a graceful dedication to the memory of the illustrious Halifax, was the unfortunate cause of Pope's quarrel with Addison, who esteemed it higher than the jealous poet could brook. Tickell accompanied Addison to Ireland, and in 1717 became his under-secretary of state. Tickell bemoaned the death of his great friend in one of his finest poems, addressed to the Earl of Warwick. In 1725 Tickell was made secretary to the lords-justices of Ireland, an office of great honour, which he retained till his death, which took place in Bath, 23rd April, 1740.

TICKET-DAY, on the Stock Exchange. See article SETTLING DAY.

TIDES. The tides are a series of oscillations or periodical movements of the waters of the sea, compounded of an alternate vertical motion, or rise and fall, and an alternate horizontal motion, or flow and ebb.

Phenomena of the Tides.—The tides keep time with the apparent motions of the moon and sun. The principal movements of the tides keep time with the apparent diurnal motion of the moon: the mean duration of a complete tide, from one high water to the next, being twelve hours twenty-four minutes very nearly, or just half a lunar day

Fig. 1.



A lunar day is the interval of time between two successive transits of the moon across the meridian. In describing the phenomena of the tides it is sometimes convenient to speak of lunar hours, a lunar hour being one twenty-fourth part of a lunar day, or about one hour and two minutes of solar time. In the open sea, or in a clear and deep channel, the law which connects the vertical motions of the particles of water with the lapse of time is nearly that represented as follows (see fig. 1). Let B C represent the mean level of the sea; and D E, at right angles to B C, and bisected by it in A, the extent of rise and fall of the tide. About A, with the radius A D $= \frac{1}{2}$ D E, describe a circle. Let a point (such as F) be supposed to travel round that circle at a uniform speed twice in a lunar day; then at any given instant the perpendicular distance, F G, of that point from B C will represent approximatively the elevation of the surface of the water above or its depression below the mean level of the sea, the interval which has elapsed since high water being represented by the arc D F. There are subordinate movements of the tides which keep time with the apparent diurnal motion of the sun, and others which keep time with the apparent monthly and annual motions of the moon and sun, the result being that the duration of the tide, and the extent of motion of the water, both vertical and horizontal, undergo variations of different sorts, whose periods are a lunar day, half a lunation, a whole lunation, half a year, and a year.

Of those variations the most conspicuous is that variation of the extent of rise and fall whose period is half a lunation; and which constitutes the difference between spring tides and neap tides. Spring tides are those during which the extent of motion is greatest; and they occur at, or soon after, new moon and full moon. Neap tides are those during which the extent of motion is least; they occur at, or soon after, the moon's completing the first and third quarters of the lunation.

At a given place the interval of time from the moon's transit to the instant of high water, although not absolutely uniform, has a mean value from which it never deviates far: that mean interval is called the *establishment* of the tide at the given place; and when it has once been ascertained by observation it serves afterwards to calculate approximately the time of high water from the time of the moon's passing the meridian. There is also, at a given place, a nearly constant interval from the time of new or full moon to the time of the next spring tide; this is called the *age* of the tide at the place in question.

The vertical movements of the water are, on the whole, the more conspicuous to the eye, in ordinary cases ranging from 3 to 20 feet. But the horizontal movements, or tidal currents, are by far the greater, for they often extend to many miles.

The horizontal and vertical movements of the water are connected with each other, for the rising and falling of the surface of a liquid at a given point are necessarily accompanied by motions of the neighbouring particles towards and from that place. There are, and must always be, currents in the sea towards a place where the tide is rising, and from a place where the tide is falling. But the consequences of this principle, as regards the relations between the times of high and low water, and the times of flood and ebb, are different according to the situation of the part of the sea in question. In the *open sea*, or in the *middle of a clear and deep channel*, the tidal movements are analogous to those in a series of very long and swift waves. The orbit of each particle of water is a very long and flat ellipse, standing in a longitudinal vertical plane, the horizontal diameter of the ellipse being the extent of motion in the flow and ebb, and the vertical diameter the extent of rise and fall. When the front slope of one of those waves reaches a given spot, the surface of the water there is *rising*, as regards its vertical motion. As soon as it begins to rise above the mean level of the sea the particles begin to be pushed forward by those in the high part of the wave behind them, and the *flood-current* commences. That current goes on increasing in speed as the wave advances; and by the time the crest of the wave has arrived at the place in question (that is, at the instant of high water) the flood-current is running at its greatest

speed. After the passage of the crest, and during the passage of the back slope of the tidal wave, the surface of the water is *falling*. At the same time the flood-current gradually subsides, and ceases when the surface of the water has returned to the mean level of the sea. As the surface of the water continues to sink the *ebb-current* gradually sets in, and reaches its greatest speed by the time the trough of the wave has arrived at the place in question—that is, at the instant of low water. The total rise and fall of the tide never exceeds a foot or two in the open sea. At a point in the German Ocean north of the English Channel a flood-tide through the Straits of Dover meets an ebb-tide from Scotland, and *vice versâ;* at this point actual equilibrium is maintained.

When a sea or channel, such as that just referred to, is bounded by a line of coast having a *beach* of moderate slope, the motions already described are combined on and near the beach, with a *seaward current* during the fall, and a *shoreward current* during the rise of the tide. The general rise and fall of the tides is 30 to 40 feet along the west coast of England, 18 feet at London and along the south-east coast, and 7 to 9 feet along the Channel.

The tide in a *short inlet*, or in any bay, gulf, estuary, or harbour, of such dimensions and figure that high and low water occur in all parts of it sensibly at the same instant, is analogous to the emptying and filling of a reservoir. There is an inward current during the rise of the tide—slack water at high water; an outward current during the fall of the tide, and slack water again at low water; and the current is swifter and stronger when the depth of water is greater: that is, during the second half of flood and the first half of ebb.

In *gradually shallowing water* the propagation of the tide waves is both retarded and deflected, the crests of the waves having a tendency to become parallel to the line of coast which they are approaching.

In *deep inlets* which become gradually narrower the concentration of the tidal motion within a diminishing space causes its extent in some cases to augment enormously; for example, the spring tides in the Bristol Channel sometimes rise and fall 50 feet, and those in the Bay of Fundy 120 feet. Tides in narrow seas, and in the neighbourhood of land generally, are modified by the interference of different series of waves arriving by different routes, so as sometimes to present very complex phenomena.

In *river channels* the alternate currents due to the tides are combined with the downward current due to the stream of fresh water; and the rise and fall due to the tides take place, not above and below the mean level of the sea, but above and below the sloping surface which the stream would assume if the sea always stood at its mean level.

The tidal wave which is propagated up a long inlet or river channel diminishes in length and increases in height until it reaches a limit where its further increase in height is stopped by friction. Its front becomes shorter and steeper, and its back longer and flatter; in other words the rise of tide occupies a shorter time, and the fall a longer time, as the wave advances up the channel. When a high tidal wave advances into very shallow water its front sometimes shortens and steepens, until at length it curls over, and continues to advance, rolling and breaking into surf, followed by a very long flat back. The tidal wave is then called a *bore*. The back of the wave sometimes breaks up into two or three smaller waves, and then the fall of the tide is interrupted by short intervals of rise.

In land-locked seas and lakes which have either a very narrow opening to the ocean, as the Mediterranean, or no opening, as the Caspian Sea, the tides are insensible, or nearly so.

A line drawn on a map through all the places at which it is high water at the same instant is called a *co-tidal line;* and in cases where there is no intricate combination of tidal waves, it may be regarded as showing the position and figure of the crest of the tidal wave at that instant. Plate I. shows a series of co-tidal lines on part of Mercator's chart of the world; Plate II. on a map of the British Isles and neighbouring seas. The Roman numerals on each line show the hour of high water, in Greenwich time, to which it corresponds on the days of new and full moon. In the South Pacific and Antarctic oceans the tidal wave advances from east to west, following, or seeming to follow, the apparent diurnal motion of the moon; but in all other seas its direction of advance is either modified or wholly governed by the form of the channel and of the adjoining lands.

Theory of the Tides.—From the fact of the tides keeping time with the motions of the sun and moon relatively to the earth, it is obvious that they must be caused or kept up by forces exerted by those bodies. This has been known from remote antiquity. Newton was the first to show the nature of those forces—viz., that they consist in the differences between the attractions exerted by the two luminaries on the solid body of the earth, and the attractions exerted by them on the particles of the sea.

The forces which keep up the tidal motions belong to the class called *disturbing forces* in astronomy. In fig. 2 let

Fig. 2.

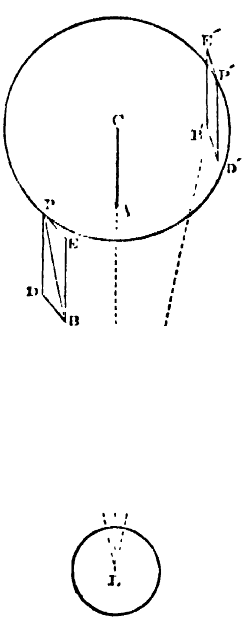
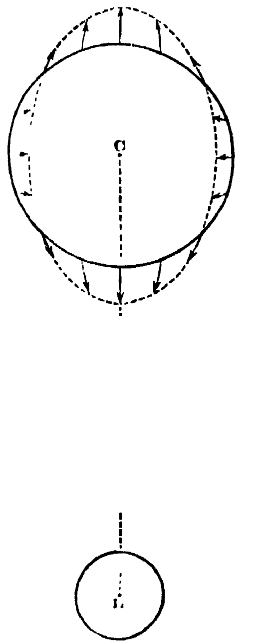


Fig. 3.



C represent a particle of matter at the centre of the earth, and P a particle of equal mass at its surface. Let L be some external body, such as the sun or moon; this may be called, for the sake of a general term, *the luminary*. Let C A and P B represent the attractions exerted by the luminary on the particles C and P respectively. Then, because gravitation varies inversely as the square of the distances, $\frac{PB}{CA} = \frac{LC^2}{LP^2}$. Draw P D equal and parallel to C A, and complete the parallelogram P D B E. By this operation the force P B is resolved into two components, P D, equal and parallel to C A, and P E. The only effect of the force P D is to make the particle P move in precisely the same manner with the particle C; so that this force neither alters nor tends to alter the position or motion of

those particles relatively to each other. But the other component, PL, is a force applied to P alone, and no equivalent force is applied to C; and this is a *disturbing force*, tending to alter the position and motion of the particle P relatively to the centre of the earth, C. If P is one of the particles of the solid body of the earth, the disturbing force is resisted by the rigidity of the earth; but if P is a particle of the sea that force takes effect, and produces tidal motions. By a similar construction it is shown that the disturbing force exerted on a particle such as P′ is represented by P′ E′.

In fig. 3 the arrows show the general character of the disturbing force at points of the earth's surface variously situated relatively to the luminary. It will be seen that at both ends of that diameter of the earth which traverses the luminary the disturbing force acts from the earth's centre, or upwards; that at both ends of the diameter at right angles to the first-mentioned diameter it acts towards the earth's centre, or downwards; and that at intermediate points it has various directions, horizontal and oblique, which are all inclined towards the luminary on the side of the earth that is nearest to it, and from the luminary on the further side of the earth. It is sometimes felt to be a difficulty that the disturbing force on the further side of the earth should be acting against the moon's attraction; but the matter may be put very roughly thus: On the near side the moon pulls the waters away from the earth, because she attracts the nearer body the most, and on the far side the moon is pulling the earth away from the water, since the earth is nearer to her and is the more powerfully attracted. But these effects are precisely the same as if a force equal to the difference of attraction were pushing the waters away from the earth in each case.

Each particle of the sea, then, is acted upon by a disturbing force exerted by the moon, which goes through a cycle of changes of amount and direction twice in a lunar day; and by another disturbing force exerted by the sun, which goes through a cycle of changes twice in a solar day.

Newton proves further that the disturbing forces exerted by two luminaries on the same particle are directly as their masses, and inversely as the cubes of their distances. The mass of the sun is about 28,000,000 times that of the moon, and its distance from the earth is about 400 times greater; therefore the disturbing force produced by the sun is to that produced by the moon nearly as 28,000,000 to $400^3 = 64,000,000$, or as 7 to 16. The principal tidal movements, then, are those which keep time with the moon. The disturbing forces exerted by the sun and moon are combined. When the sun and moon are in *syzygy*, that is, in one straight line with the earth, the disturbing forces caused by them are in the same direction, and the resultant disturbing force on any particle is the sum of its two component forces. When the sun and moon are in quadrature, that is .. directions from the earth which make a right angle, the disturbing forces caused by them are opposed to each other, and the resultant disturbing force is the difference of its two components. Hence it appears that the resultant disturbing force on any particle at new and full moon is to the resultant disturbing force on the same particle at the first and last quarters as $16+7=23$ is to $16-7=9$; the former produces a spring tide, the latter a neap tide. There are other fluctuations in the disturbing force, depending on the distances of the luminaries from the earth and on their declination; and these have fluctuations in the tides corresponding to them.

Newton thus completely discovered the forces which produce the tides, and he also demonstrated in detail their mode of operation in the simple and extreme cases of a globe covered with a comparatively shallow ocean, and of a globe consisting entirely of water; Laplace, Young, and Airy made still further progress by the investigation of the mode of operation of these forces in more complex circumstances; but a complete theory does not yet exist.

TIECK, LUDWIG, an illustrious German poet, was born at Berlin on the 31st of May, 1773, of a respectable, though not a noble family. He was educated at the universities of Halle, of Göttingen, and of Erlangen, where he especially devoted his powers to the study of history and literature; and on his return to his native city he entered upon a literary career by translating tales and sketches for the periodical conducted by Musæus and J. G. Müller, the *Straussfedern*. Having thus proved his powers he essayed works of weightier calibre and higher aim; the novels "Abdallah" (1795), "William Lovell" (1795), "Peter Lebrecht," and "Peter Lebrecht's Volksmährchen" (1797). These productions were characterized by a simplicity and a realism in strange contrast to the idealism, rich fancy, and ornate style of their successors: "Romantische Dichtungen," "Kaiser Octavian," and "Phantasus" (1812–15), the latter a prose poem of great beauty, which deserves to be better known in England. While giving vent to his genius in these rapid utterances, Tieck was wandering over half Europe. We find him at Dresden in 1801, at Munich in 1804; he travelled in Italy in 1805; again visited Dresden and Munich, and went to England and France in 1817. Two years later he took up his residence at Dresden, where he gathered round him a literary circle of great brilliancy, and gave an active superintendence to the dramatic performances at the royal theatre. In his old age he was summoned to Berlin by the late King of Prussia, who pensioned him, and consulted him on the production of the "Antigone" on the Berlin stage. His health, however, gave way, and after a long illness he died on the 28th of April, 1853. Apart from his original works Tieck contributed greatly to the development of the romantic school of German literature by his translations from the English dramatists of the Elizabethan era.

TIEN-TSIN, a large commercial city of China, and the port of Pekin, from which capital it is nearly 70 miles south-east, at the confluence of the Yuen-ling and the Peiho Rivers. It imports grain, woollen and cotton stuffs, metals, needles, matches, hemp, sugar, opium, and silks. It is also a great entrepôt for salt. The exports are mainly alum, apples, cotton, dates, drugs, horns, paper, seed, skins, soap, and tobacco. The streets of the town are unpaved, and the houses built of mud or dried bricks. The extremes of heat and cold are excessive: in the summer the thermometer reaches 106°, and in the winter it falls to 6° below zero. During three months of the year the river is frozen over, and the traffic carried on by means of sledges. The port was opened to foreign trade by the treaty concluded at Tien-tsin in 1858, after the taking of the Taku Forts at the mouth of the river by the British, since which its commerce has greatly increased, and the railway and the telegraph have been introduced. The population is variously estimated at from 200,000 to 900,000.

A horrible outrage took place here on the 21st June, 1870, when the French consulate, the Catholic mission, and the hospital of the French sisters of charity were attacked by a Chinese mob, and the consul, some priests, merchants, and the sisters—in all, twenty persons—were massacred with diabolical cruelty, and about 100 children burnt with the hospital. The principal reasons appeared to be a fanatical dislike to the missionaries, founded mainly on fabricated tales of their evil practices. Great indifference was manifested by the Chinese authorities; and the powerlessness of the French representative at Pekin, in consequence of the war with Germany which broke out about this time, encouraged them in a temporizing course. The serious threats of England, however, and the appearance of a naval force at Chefoo, had some effect; and in October sixteen of the guilty men were executed, and an indemnity of about £160,000 was paid to the French.

TIEP'OLO, GIOVANNI BATTISTA, born at Venice in 1696 (the son of a ship-chandler), was of the school of Paolo Veronese, and acquired a great reputation as a fresco painter. Tiepolo's colouring is remarkably brilliant, but his execution is mannered and slight, the general effect, in his oil pictures especially, being broken and spotty by his habit of closely contrasting opposed tints. He spent three years working for the bishop at Wurzburg, and at sixty-six he set out, as it proved, to pass the last eight years of his life in Spain, in the service of Charles III. He died at Madrid in 1770. Memoirs of Tiepolo have recently been produced by Urbani (Venice, 1879) and Molmenti (Turin, 1885). His reputation is of late years rapidly rising. Some of his work in engravings was exhibited at the British Museum in 1887, and was much admired.

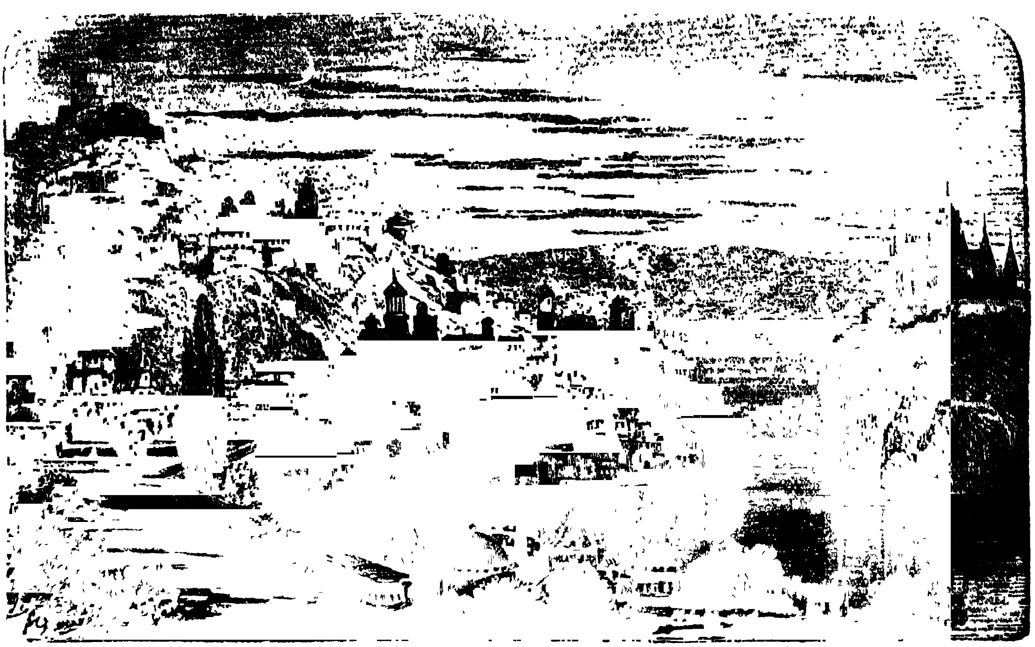
TIERCE, a weight by which provisions are sold. A tierce of beef for the navy is 304 lbs. Formerly, in liquid measures, a tierce was reckoned at 42 gallons.

TIERCE DE PICARDIE, the major triad, used almost invariably down to the present century as a conclusion to a piece of music in the minor. Even Mozart shrank from closing with a minor triad, and that close was practically unknown before his time. Now the *tierce de Picardie* is very rarely used, composers preferring to maintain the minor mode to the end. Why Picardy should give the name to this close is at present unknown.

TIER'RA-DEL-FUE'GO, a group of islands separated from the mainland of South America by the Strait of Magellan. There are five principal islands—King Charles' South Land, 260 miles long from east to west, by 180 miles broad; Land of Desolation, Clarence, Hoste, Navarin, and a great many smaller. The most southerly is that of Cape Horn. The western side of the group, towards the Pacific, is elevated, rugged, and broken, consists of granite, gneiss, and mica slate, with many garnets; to this succeeds a great formation of dark-coloured hard slate, containing chalk fossils; and the eastern side is composed of a vast tertiary formation. With the two latter ancient volcanic products are largely intercalated. The name Tierra-del-Fuego ("Land of Fire") is believed to have been given by Magellan because, in passing through the strait, he and his companions saw many fires in the woods on that side of the channel, which were probably lighted by the natives, who are now known to keep their fires constantly burning, from the difficulty of relighting them in a climate in which gales, rain, and sleet are characteristic. The humidity of the climate, and the open character of the winter, render the vegetation more varied and abundant than might be expected under a climate which is one of the most inhospitable on the surface of the globe and unfitted for the abode of civilized man. The people are a peculiar and stunted race of the American-Indian family, and exhibit little intelligence, except in their extraordinary power of mimicry. Missionary effort, has, however, it is said, done much to improve their condition of late years. Their number is estimated at only about 1000.

TIERS ÉTAT, the third branch of the French estates, consisting of representatives of the commercial interests of the towns and of the rural peasantry. It was summoned for the first time in the fourteenth century by Philip the Fair. In the great French Revolution the Tiers État exercised a tremendous influence; for when the two other estates (those of the nobles and the clergy) refused to join in their deliberations, the Tiers État, with such of the nobles and clergy as joined them, declared themselves the sole legislative power, under the title of *L'Assemblée Nationale.*

TIF'LIS or **TEFLIS,** the capital of the Russian government of the same name, is situated nearly midway



Tiflis.

between the Black Sea and the Caspian, on the Kur, at the southern extremity of a rocky defile formed by high and barren hills. The larger portion of the town is built on the right bank of the river, and contains the houses of the wealthiest inhabitants, the great bazaar, the principal squares, the finest churches, the public offices, the residence of the military governor and of the commander-in-chief. Some of the Armenian churches in Tiflis, of which there

are a large number, are very handsome; the cathedral, in particular, being a large and striking edifice. At a point where the river in its course through the city is hemmed in by rocks, a bridge of a single arch connects the town with the suburb of Awlabar. This bridge is 1100 feet above the level of the Black Sea.

There are manufactures of carpets, silks, and shawls, celebrated hot baths, and an ample supply in season of exquisite fruits, as peaches, apricots, almonds, figs, and grapes. In many houses of the natives common paper, or oiled paper, may be seen as a substitute for glass in the windows, or the doorway answers the purpose of a window. Tiflis is about 1750 miles from St. Petersburg. From hence starts the military road across the Caucasus, following the valley of the Kur, and its affluent the Aragua, until it enters the mountain region, which is traversed by the pass known to the ancients as *Portæ Caucasiæ*, now commonly called the Pass of Dariel. This is a series of tremendous defiles, extending altogether not far short of 100 miles, often so contracted as scarcely to afford room for the waters of the Terek to foam through on the northern side. Tiflis is connected with Teheran by telegraph, and the railway is to be extended in that direction. The population in 1820 was 15,000; in 1883 it was 104,024.

TIGER (*Felis tigris*) is the largest and most active of the great cat tribe (FELIDÆ). It is entirely confined to Asia, where its range is very extensive, from the Caspian Sea to the Island of Saghalien, and from Siberia to the Malay Archipelago. It is most abundant in Northern India. The royal tiger is superior even to the lion in size, strength, and activity. The body is more slender and cat-like than that of the lion, and there is no trace of a mane, nor is the tail tufted; the head is also rounder and the muzzle shorter. The ground colour is a rich orange or tawny-yellow, passing into white on the under parts. The whole body is beautifully striped with black transverse irregular bands, which are continued as rings on the tail. The back of the ears and the face are also marked with white. The colour varies according to locality and climate, being much lighter in more northern latitudes. In the mountains of Northern China the tigers have the body covered with long hairs instead of the close fur of the tigers of Bengal.

Being a shy, morose animal, the tiger is usually found roaming about by himself; but at certain seasons his mate is sure not to be far from him. His food consists of the ordinary domestic cattle, deer, wild hogs, peafowl, and even smaller animals. The prey is suddenly struck down, mostly during the night, seized by the throat, and dragged off into some secure spot by the nearest stream or jungle. Here he eats what appetite requires at once, and leaving the carcase, retires to some smooth lair hard by, returning after a period of sluggish repose to take another meal. The succeeding night he shifts his hunting ground, especially if it be the rainy season; but if it be the summer heats he does not move far from the patches of long grass which adjoin some pool or swamp, where he may bask in the shade during the day and prowl by night round some neighbouring village in hopes of securing an ox. In his nocturnal travels he rarely goes less than 15 miles, and often twice that distance, during the night.

The tigress is smaller and lither than the male, and, when accompanied by her young, is more savage and bloodthirsty. Though usually defending her young with the greatest courage, if hard pressed for food she will sometimes desert and even eat them. As for the young tigers, they are far more destructive than the old, killing three or four cows at a time, for the mere pleasure of killing, whereas an older tiger rarely kills more than one victim at a time. Buffaloes have an instinctive knowledge of the approach of a tiger, and exhibit a rooted aversion to him, snorting and tramping up and down, and forming into a circle to receive his attack on their lowered horns.

Much difference of statement prevails as to the size attained by tigers, partly owing to the fact that the skin when removed is apt to stretch. Instances are recorded of tigers of 12 feet in length; but Sir J. Fayrer, while estimating the length of tigers from the nose to the tip of the tail as ranging from 9 to 12 feet, deems one of 10 feet a large specimen. In height at the shoulder the animal usually stands $3\frac{1}{2}$ to 4 feet.

The same peculiarity which exists in the domestic cat in "whetting its claws" is observable in the tiger. Just as the cat practises upon the legs of our kitchen tables, or anything of the same kind that offers itself, the tiger is fond of scratching the bark of trees, perhaps in order to keep his terrible claws in serviceable condition—many trees in the jungle, especially the Indian fig, being often found deeply scored by these weapons from a height of 10 or 12 feet from the ground.

The deaths from snake bite alone in India amount to about 10,000 per annum, and a devastation little less horrible arises from the man-eating propensities of tigers. These occasionally cause villages, and even whole districts, to be deserted. In one instance, in the Central Provinces, a single tigress caused the desertion of thirteen villages, while 250 square miles of country were thrown out of cultivation before the creature was shot. Another tigress, in 1870, killed 127 people, and stopped a public road for many weeks before it succumbed to an English sportsman. In the district east of Jubbulpore alone during many years nearly 300 villagers were killed annually. In Madras Presidency the loss of life and property caused by tigers caused the government to appoint an officer for the express purpose of destroying them. In Bengal and some other parts a reward is offered the natives for tigers' heads; but out of about 1200 tigers killed annually in Bengal, the greater part falls to the rifles of European sportsmen.

When it is remembered that, besides the loss of life referred to, the loss of property which the ravages of Indian carnivora entail is estimated at £10,000,000 annually, it must be considered fortunate that tiger shooting presents so many charms to its votaries. The animal is reported also to have considerably increased throughout India since the general disarming of the natives after the mutiny, so that there is little fear of the chase soon dying out. There are several modes of tiger hunting popular in India. In Bengal, Central India, and the North-western Provinces, he is pursued into his native jungles by sportsmen mounted on elephants; or he is driven by the native beaters along defiles and woodland ways, where he is shot from platforms constructed in the trees, which overhang the path he must take. In Madras, Bombay, and South India generally, where but few elephants are kept, the tiger is often hunted on foot; but it is in this kind of sport that the most serious and fatal accidents occur, no foresight or readiness with firearms being always able to stop a wounded tiger's rush.

In shooting tigers from elephants, it is important to be well mounted. A good elephant, well trained to the sport, will stand the tiger's charge, and even rush to meet him; then comes the rider's chance to shoot him in a fatal spot, else he often springs on the elephant, and endeavours to reach its mahout (driver) or the sportsman in the howdah. Accidents not unfrequently happen in the confusion which ensues, the elephant trumpeting and rushing about in pain and fear, while the occupants are being lacerated by the tiger's claws, or endangered by their friends' fire. In other cases, an elephant on being thus attacked and severely clawed, has been known to run away, and dash its howdah off under the boughs of the trees in its way; and if its riders escape the danger of thus being dashed to pieces, they are thrown to the anything but tender mercies of the tiger below.

In shooting from platforms erected in trees there is

much excitement, and not a little spice of danger in the sport, as although tigers do not climb trees, they can bound an enormous distance, and have been known to leap into the machân or platform in the tree. Should a tiger be known to be in a district, a three-year-old buffalo is sometimes obtained and tethered securely in a path of the jungle. The lair in which the tiger is reposing after his meal, is found next morning by the natives, and he is surrounded by a large assemblage of beaters, who noisily drive him onward to where the sportsmen are waiting in their machâns. On reaching these he is at once fired upon. Often he fights, and dies there; but sometimes he escapes into the jungle. His vitality is extraordinary, and it is a dangerous task to follow him. The usual course is to drive a herd of buffaloes in. As they detest a tiger, they enter fully into the sport, and finding him wounded speedily kill him with their horns; or if he be dead, they prance round him and toss him about with their horns.

Other methods of ridding themselves of such a terrible foe are sometimes employed by the natives of the various countries which it inhabits, such as shooting it with poisoned arrows, snaring it in pitfalls and traps, &c. The natives of India and other parts hold the tiger in such superstitious reverence that they often prefer to endure its ravages rather than seek to kill it themselves. In spite of its immense strength and ferocity the tiger appears to be naturally a cowardly animal, and is said to rarely attack except from ambush. It seldom attacks an armed man except when provoked, though often seizing on women and children. The tiger swims well.

The tiger does not breed very fast. The female brings forth from two to five cubs at a time, which remain with her till about the second year, when they are nearly full grown. At this time she is wantonly destructive, killing apparently to instruct her young ones.

When taken young the tiger is easily tamed, but as its temper is apt to break out on slight occasions, it is not to be incautiously trusted. The tame tigers of the mendicant priests or fakirs of Hindustan are well known.

Hybrids have been produced in captivity between the tigress and lion, but have not survived to maturity. The tiger was well known to the Greeks and Romans. According to Pliny the first tiger seen at Rome was a tame one belonging to Augustus. ("The Royal Tiger of Bengal," by Sir J. Fayrer, M.D., F.L.S., London, 1875.)

TIGER BEETLE. See CICINDELIDÆ.

TIGER CAT is the name applied to some of the smaller species of the family FELIDÆ, especially to those which resemble the TIGER in their form or markings. The largest and most handsome of these is the Rimandahan or Clouded Tiger (*Felis macrocelis*), a native of Assam, Siam, the Malay Peninsula, Sumatra, Java, and Borneo. It is over 3 feet long, exclusive of the tail, which measures nearly another 3 feet. The body is cylindrical, the head rather small, with short rounded ears, and the legs robust and rather short. The ground colour is brownish-gray, with irregular cloud-like patches and bands of deep velvet-black. The tail, which is thick and full, is beautifully ringed with black. According to Sir Stamford Raffles, who first introduced this species into England, the clouded tiger is not dreaded by the natives, but lives chiefly on poultry, birds, and small deer. The Viverrine Tiger Cat (*Felis viverrina*), a native of Bengal, Burma, China, and the Malay region, though smaller, is far more ferocious than the former species. It frequents the neighbourhood of water, and feeds on fishes, molluscs, and birds. It often kills dogs and young calves, and instances have occurred of its taking native children from their huts. It is about 2½ or 3 feet long, grayish in colour, banded and spotted with black. Other tiger cats, which are separately noticed, are the OCELOT (*Felis pardalis*), MARGAY (*Felis tigrina*), EYRA (*Felis eyra*), SERVAL (*Felis serval*), and JAGUARONDI (*Felis Jaguarondi*). The Pampas Cat (*Felis pajeros*) and the Chaus or Jungle Cat (*Felis chaus*) are described in the article CAT. The Chati (*Felis mitis*) is probably not distinct from the Margay.

TIGER FLOWER (Tigridia) is a small Mexican genus of plants belonging to the order IRIDEÆ, much cultivated in our gardens for the beauty of its flowers. The flowers, which are very evanescent, are of a brilliant orange or yellow colour, richly variegated with darker spots. The perianth has a short tube and a six-parted spreading limb, the outer segments of which are larger than the inner, concave at the base, and forming together a cup; the three inner segments are smaller, and somewhat resemble a fiddle in shape; there are three stamens, with their filaments connate into a long tube; the ovary is three-celled, with a long thread-like style, terminating in three stigmas. The stem is bulbous, and the leaves sword shaped and much plaited. Two species are recognized by some, *Tigridia pavonia*, with the flowers scarlet and yellow, with black spots, and *Tigridia conchiflora*, with flowers orange and yellow, spotted with black; and several varieties have been established in cultivation.

TIGER MOTH (Arctiidæ) is a family of MOTHS belonging to the group Bombycina. The Common or Brown Tiger Moth (*Chelonia caja*) is one of the largest and most handsome of our British moths. It measures from 2 to 3 inches across the expanded wings. The fore wings are of a rich dark brown colour, with interlacing cream-coloured markings. The hind wings are deep crimson, with large black spots, bordered with yellow. The abdomen is red, with black markings, and the thorax is brown and hairy. The coloration is, however, subject to great variation. The caterpillar is known by the name of Woolly Bear, being covered with tufts of long hair. When alarmed it has the habit of rolling itself up into a ball. It feeds chiefly on the leaves of the dead nettle. It spins a kind of silken hammock, in which it undergoes the change into a pupa. Another rarer British species is the Cream-spot Tiger Moth (*Chelonia villica*). It is a smaller moth, with the fore wings black, marked with patches of creamy white, and the body and hind wings rich orange, with black marks. The Ermine Moths (Spilosoma), which also belong to this family, are so called from their soft downy wings, variegated with blackish spots. Two species are common in our gardens, the Large Ermine Moth (*Spilosoma menthastri*), which is yellowish and white, with dark spots, and the Buff Ermine Moth (*Spilosoma lubricipeda*), which is buff, marked with similar spots.

TI'GRIS, a famous river of Asiatic Turkey, which rises in the mountains of Armenia, near the salt lake of Moden, north-west of Diarbekr, at an elevation of 5050 feet above the sea, and receives a large branch from the vicinity of Betlis. It flows generally south-east, passing Diarbekr (1985 feet), Mosul, and Bagdad; at Korna it unites with the Euphrates; entire course, 1180 miles. At Mosul it is 100 yards wide, and 353 feet above the sea; at Bagdad, 200 yards; and it forms rapids over ledges of rocks between these places. It flows over the great elevated mountain valleys of the frontier chain, composed of tertiary, gypsiferous, nummulitic, and cretaceous deposits, as far as 35° N. lat., near the entrance of the Zab, and transports in its rapid current a great quantity of detritus. During the floods, which occur in December, and again in April and May, the current has a velocity of 4½ miles per hour: and the discharge of water at Bagdad is estimated at 164,103 cubic feet per second. In 1849, a deposit of 6 feet of alluvium took place here from a single flood. Beyond the alluvial banks over the entire valley of Mesopotamia, there is an older alluvium, with marine shells, showing that the Persian Gulf formerly extended 250 miles further inland. The distance between the Tigris and the Euphrates varies from 20 to 100 miles; many canals, of which some are

still open, formerly connected them. The Tigris had an independent channel in ancient times, till soon after the period of Alexander the Great, when it formed a union with the Euphrates. This takes place at Korna, 100 miles from the sea. The river has a smaller body of water, is less deep and suitable for navigation than the Euphrates, but rafts descend it from Mosul, and at times of flood even from Diarbekr. There is a considerable traffic carried on below Bagdad, by means of rafts supported on inflated skins. These are also used now, as in ancient times, by the inhabitants in crossing the river. The name Tigris is believed to be a corruption of Tigra, Medo-Persic for an arrow, and was probably given to it in consequence of its swiftness in the upper part of its course. The ruins of Nineveh, Seleu-Keia, Ktesiphôn, and Opis are on its banks.

TIL'BURY FORT, a celebrated stronghold on the north or Essex bank of the river Thames, about 24 miles from London, and immediately opposite Gravesend, in conjunction with whose recently enlarged lines of fortification, and the batteries at Shorne Mead, it completely commands the approach to London. As early as 1402 some kind of defensive work seems to have existed here, but the first block house was erected by Henry VIII. in pursuance of his scheme to protect the English coast from hostile attack. After the Dutch inroad and attack upon the ships in the Medway, a regular fortification was erected at Tilbury, which, having been repeatedly enlarged and strengthened, is now a formidable work, encompassed by a deep wide fosse, and provided with several batteries of the heaviest ordnance. The garrison are able at any time to lay the whole surrounding level under water. The gate-house of the inner court is a good specimen of seventeenth-century brickwork, curiously ornamented, and bearing the inscription "Carolus II. Rex. anno. reg. xxxiv."

TILBURY DOCKS, at Tilbury, are situated near the great docks of the East and West India Dock Company, opened in 1886, which were formed out of 320 acres of marsh land, and which can dock vessels as large as the *Great Eastern.* The total area of the main dock and its branches is 52½ acres. The construction of the docks involved an expenditure of over £3,000,000.

TILE (Fr. *tuile*), a kind of thin brick, or plate of baked clay, used chiefly for covering roofs, but occasionally for paving floors, constructing drains, &c. In the ancient buildings of Greece and Rome tiles were made of baked clay, marble, bronze, &c.

The process of making tiles is so similar to that of brick-making [see BRICK], that it will be sufficient to observe that only the best qualities of brick-earth are fit for the purpose. The roofing tiles used in this country are chiefly of two sorts, *plain-tiles*, which are flat, of a rectangular form; and *pan-tiles*, which also have a rectangular outline, but are bent in such a manner that, when laid on the roof, the greater part of their surface forms a concave channel for the descent of water, while one side forms a narrow convex ridge which overlaps the edge of the adjoining tile. Tiles of a semi-cylindrical form, laid in mortar with their convex or concave sides uppermost, are used for covering ridges and gutters. Drain-tiles are most commonly made in the form of an arch, and laid or bedded upon flat tiles called *soles.* Paving tiles are usually square, and arranged in *sizes*, each size being one-half the superficial area of the next larger size.

Decorative paving tiles of baked pottery were much used in the middle ages, but their manufacture in England was almost forgotten until the late Mr. Minton restored it. The Temple Church, in London, was one of the first buildings in which the revival was exhibited. These tiles are in squares, generally varying in inches from 1×1, which are called tesseræ, to 6×6, and can be combined into the most effective patterns. They are generally about half an inch or a little less thick, and being very hard and true in colour, are very durable, but they require great care in laying. White, blue, and green tiles require a large quantity of flint in their composition, and are called *Vitreous Tiles.* Warm red is obtained from natural clays, and buff is also yielded by natural clays. Black is obtained by colouring the clay with manganese. Cobalt is used for blue. See TILES, ENCAUSTIC.

TILE ORE is an earthy variety of CUPRITE or red copper ore, often mixed with oxide of iron, and generally brick-red or reddish-brown in colour, though sometimes almost black.

TILES, ENCAUSTIC, a species of tiles ornamented with figures of different-coloured clays indented on their surfaces, and now largely used as a decorative pavement for public buildings, especially in churches, where they are generally glazed. The art of manufacturing them, which had long been lost, was revived about 1833 by Mr. Wight, of the Staffordshire Potteries, and soon afterwards perfected by the untiring exertions and scientific ingenuity of the late Mr. Herbert Minton.

Various improvements in the process have since been made in order to produce the most certain result. The following is that most usually employed. Two different kinds of clay are taken to make up the body of the tile, in order that by the different degrees in which they contract under heat they may rectify the tendency of the clay to bend. A rough ordinary tile clay forms the middle, and it is faced and backed by thinner layers of a finer and more carefully worked up clay. The latter is technically called "slip." This slip is first taken and beaten into a thin layer, rather larger than the iron mould, which contains a plaster of Paris cast of the intended design. The layer is pressed into the mould, the surplus clay cut off, and the edges separated from the sides with a knife. This is the facing of the tile. A deeper rim is now added to the mould, and a lump of the rough clay pressed on to the facing. This is about three-fourths of an inch thick, but after pressing about one-fourth of an inch is scraped away, and the mould is fitted up with another layer of "slip." This is the backing. After being again pressed the whole tile is taken from the mould and is laid with the impressed design uppermost upon a large flat tile called a "bat." The colouring matter is then poured over the whole tile in a liquid state, and it is left to solidify. As soon as it is sufficiently set, it is scraped off to the raised parts of the design on the facing. After drying for three or four weeks, the tile is then fired for sixty hours at a heat in proportion to the hardness and colour required. Such a tile is about half an inch thick, and the design is generally about one-eighth to one-sixteenth of an inch deep.

"Inlaying" is the method by which a great variety of colour is obtained, and is accomplished by placing thin coatings of differently coloured clay upon the proper portions of the plaster cast, and then laying the facing layer of "slip" over them as before. It may be mentioned that the encaustic tiles of the middle ages found in churches and monasteries, many of them with the most beautiful designs, appear to have been very imperfectly fired, for in many the colour of the clay is not uniform throughout.

TILIA'CEÆ is an order of plants belonging to the group POLYPETALÆ, cohort Malvales. [See BOTANY.] The species are numerous, and are generally diffused throughout the tropical and temperate parts of the globe, being most abundant within the tropics.

The Tiliaceæ possess no active properties; they abound in a mucilaginous wholesome juice. The fibres of the inner bark are very tough, and are used for a variety of economical purposes. The fibres of the LIME TREE or Linden (*Tilia Europæa*) are manufactured into ropes and mats, especially in Russia and Sweden. JUTE is the inner bark of species of Corchorus, much cultivated in India for making mats, coarse carpets, bags, &c. The

wood is generally white, light, and tough. The wood of the lime tree is largely used by cabinet-makers and for carving; that of *Grewia elastica* is used for making bows in India. The Trincomalee wood used at Madras for making the Massoola boats is the produce of *Berrya Ammonilla*. *Corchorus olitorius* is cultivated in Egypt for use as a pot-herb. The berries of some species of Corchorus and Elæocarpus are edible; and those of species of Grewia are agreeably acid and are used in making sherbet. Some of the tropical species are cultivated as stove plants for their beauty.

The species are trees and shrubs, rarely herbs, with alternate stipulate leaves and regular flowers, usually arranged in cymes. The calyx is valvate, consisting of four or five deciduous sepals; the corolla has four or five petals, or is sometimes wanting; the stamens are numerous, hypogynous, distinct, or polyadelphous, with two-celled anthers; the ovary is free, two to many celled.

TILLAND'SIA is a genus of plants belonging to the order BROMELIACEÆ. Most of the species are natives of America and the West Indies, and are epiphytes, with their foliage covered with scurfy scales. *Tillandsia utriculata*, the wild pine of the colonists of Jamaica, is found growing on old and decaying trees in the forests of Jamaica, and also in Florida. The stem is 3 or 4 feet high and the leaves are nearly a yard long, and placed within one another in such a way that the water which runs down them is retained in their dilated bases; in this way forming a kind of reservoir, which, being contracted at the neck, prevents the heat of the sun from evaporating the water. Each receptacle will hold about a quart of water, and during the dry season they are the resort of all kinds of animals, while travellers are often able to obtain a supply from this source when all others fail. *Tillandsia usneoides* (the long moss or Spanish moss) is a native of the forests of North America, from Virginia to Florida, and also of the West India Islands and South America to Chili. This species is common in forests, clothing the trees with the sombre greenish-gray [illegible] its stems and leave[illegible] The stems are very slender, 2 feet or more long, and bear leaves of the same colour, and scarcely broader, 2 or 3 inches in length; the flowers are produced at the ends of short branches, and are bright yellowish-green. The filamentous stems, when deprived of their bark, are used for the same purposes as horse-hair in America. They are also in some places made into cordage, and woven into mats, horse-collars, &c. The only preparation they require previous to being used is steeping in water for a fortnight or more, according to the temperature, when, on being taken out and dried, the bark easily separates from the fibres, and they are fit for use. Of late years the process has been much accelerated by the use of steam. Several species are cultivated in this country as stove plants, their singular habit being enhanced by their handsome white, blue, pink, or purple flowers.

TIL'LOTSON, JOHN, Archbishop of Canterbury (1691–94), was born of Puritan parents at Sowerby, near Halifax, in 1630. He was educated at Clare Hall, Cambridge, where he took the degree of B.A. in 1650, and of M.A. in 1654. He took orders in the Church of England, and in 1663 was appointed to the rectory of Keddington, in Suffolk, but shortly afterwards was chosen preacher at Lincoln's Inn. Here, after a time he gained a position of considerable influence, and though he had abandoned the strict Puritanism of his youth, he opposed the proclamation of Charles II. for liberty of conscience, preached earnestly against Roman Catholicism, and advocated the exclusion of the Duke of York. He stood high in the favour of William III., and in 1691 William almost forced him to accept the see of Canterbury, rendered vacant by the deposition of Sancroft. A man of mild temper and catholic in opinion, he had to encounter a great deal of hostility from the extreme men of both parties, the non-jurors being especially unrelenting in their attacks, but he performed the duties of his great office with tact and discretion, and sustained all assaults in a spirit of Christian meekness. He died 18th November, 1694, at the age of sixty-five.

His marriage with a niece of Cromwell brought him into intimate connection with Wilkins, bishop of Chester, whose posthumous works he edited, and he published "The Rule of Faith," in 1666, and several volumes of sermons. The latter for a long period enjoyed immense popularity, the copyright bringing his widow 2500 guineas; they are now, however, little read. Tillotson's works were published in three volumes (London, 1707-12), and they were afterwards edited and republished by Dr. T. Birch in 1752. See also Birch's "Life of Tillotson" (London, 1752).

TIL'LY or TILLI, JOHN TSERCLAS, COUNT OF, a distinguished German soldier, was descended from an ancient and noble family, and born at the Castle of Tilly in South Brabant in 1559. At an early age he entered the order of the Jesuits, and it was there most probably that he imbibed the spirit of intense fanaticism which, equally with military skill and prowess, distinguished his subsequent career. He served in the Netherlands under Alva and other leaders against the Protestants. [illegible] afterwards acquired much distinction in the service of the German Emperor Rudolph II., during the Hungarian and Turkish wars, and was appointed generalissimo of their forces by the League of the Roman Catholic states in Germany—an office which he held till his death. The first real laurels gained in the famous Thirty Years' War fell to the lot of Tilly. On 8th November, 1620, he gained the victory of Weisse Berg, near Prague, over the Bohemian army. After a series of signal successes, he totally routed Count Mansfeld at Stadt-Loo, near Munster, in August, 1623, and was raised to the rank of count of the empire for the victory thus achieved; while, in succeeding campaigns, the army of Christian IV. of Denmark was also thoroughly beaten by the military genius of Till[illegible]d his yet more illustrious compeer, Wallenstein. When the latter, in 1630, was deprived of his command, Tilly became field-marshal and general-in-chief of the imperial army. He had now, however, to contend with an abler antagonist than any he had before encountered, for Gustavus Adolphus was commencing his immortal campaigns in Germany. Still the first effort of Tilly proved successful. On the 10th of May, 1631, Magdeburg was captured, an event disgraced by deeds of atrocious cruelty, which appear to have been, if not ordered, at least coolly permitted by the conqueror. A few months later, in September, 1631, the great battle of Leipzig took place between the imperialists and the Swedes, which resulted in the defeat of Tilly, after a very obstinate and sanguinary engagement. With a heart devoured by rage and despair, and literally cutting his way through the main body of the Swedish army, Tilly was forced to leave the fatal field. His former good fortune now seemed to have deserted him, and at the passage of the Lech, 5th April, 1632, he received a severe wound. He expired the day after the battle.

TIL'SIT, a town of Prussia, situated on the left bank of the Niemen, near the influx of the Tilse, 60 miles north-east of Konigsberg. It has some manufactures of linens and machinery, chemicals, beer, paper and sugar, and a river trade in grain and horses; but it is chiefly worthy of notice for the signature of the famous treaty of the 7th July, 1807, between Napoleon and the Emperor Alexander of Russia on a raft in the river.

TIMAN'THES, a native of Sicyon or of Cythnos, was one of the most celebrated painters of Greece; he was contemporary with Zeuxis and Parrhasios, and lived about 400 B.C. His works were distinguished for their invention and expression. His most famous work was the "Sacrifice of Iphigeneia," in which he expressed the agony of Agamemnon, her father, by covering his face with a mantle.

TIMBER and TIMBER TRADE. Timber trees are those the wood of which is used for building or repairing houses. Oak, ash, and elm of the age of twenty years and upwards, are the trees most generally included under that denomination; but there are many other kinds, such as beech, cherry, aspen, willow, thorn, holly, horse chestnut, lime, yew, walnut, &c., which are, by the custom of certain parts of England, considered to be timber trees, as being used in building.

The timber trees upon land belong to the owner of the inheritance. If the tenant for life fells them to any amount greater than he is entitled to as estovers, that is to say, the allowance of wood necessary for the reparation of houses and fences, he becomes liable to an action of waste; and the trees, which by these or any other means, accidental or otherwise, have become severed from the land, may be seized by the owner of the inheritance, or an action may be brought by him for them. If, however, the estate of the tenant for life be without impeachment of waste, he has a right to fell timber, and he is also entitled to all timber trees which are felled or blown down during his life.

The timber growing on copyhold estates is, by the general custom of most manors, the property of the lord, who may cut it down, provided he leaves a sufficient quantity for the repairs of the copyhold, which the copyholder is entitled to. But the general right of the copyholder to have timber for the reparation of houses and for ploughbote and hedgebote may be restrained by custom, namely, that he shall not take it without assignment from the lord or his bailiff. A copyholder in fee may, by the particular custom of the manor, have a right to cut timber trees growing on his copyhold, and sell them; and the same right may belong by custom to a copyholder for life, who is entitled to nominate his successor, as being a *quasi* copyholder in fee. In Scotland planting is protected, and the destruction of trees is made an offence by several old statutes.

For many centuries the woods and forests of England were sufficient to supply all the timber required for the building of houses and ships, as well as for fuel. Complaints as to their exhaustion seem to have been first made in the sixteenth century, and an Act was passed in 1531 requiring coopers to sell their barrels at fixed prices, and ordering that exporters of beer should import clapboards sufficient to replace the barrels sent out of the country. Another Act, passed in 1541, was designed to enforce certain restrictions respecting the felling of trees, and to prevent the conversion of woodlands into pasture or tillage. In 1558 an Act was passed entitled "An Act that timber shall not be felled to make coles for the making of iron," which prohibited the use of timber a foot square in iron works within 14 miles of the sea, or within the same distance from eight of the principal rivers of England, or any navigable stream having an outlet on the coast; but three southern counties, Kent, Sussex, and Surrey, were exempt from the operations of the Act. The design seems to have been to encourage the importation of timber, and to benefit those parts of the country which did not possess a sufficient supply. In 1592 the subject again attracted notice, and an Act was passed which, among other things, prohibited aliens from exporting fish unless they imported clapboards, and altogether prohibited the exportation of wine casks. In the following century the scale of prices turned in favour of pit coal for fuel; but there was a continually increasing demand for foreign supplies of timber for other purposes, and in 1830, according to a statement of Mr. Huskisson, the fir timber used in England for building purposes was nearly all brought from abroad. The chief sources of supply were then, as now, the north of Europe, especially the countries on the Baltic, and the British colonies in North America. The timber from the north of Europe is generally of excellent quality, and for many purposes superior to that from the colonies. The inferior colonial timber was, however, for many years forced into use by enormous differential duties. In 1842 the duty on colonial timber was reduced to the merely nominal impost of 1*s.* per load, and to 2*s.* on deals and 6*d.* on lathwood; while that on foreign timber was to be gradually reduced to 30*s.* and 35*s.* per load, according to the description. The mode of charging the duty was at the same time improved and rendered less complex than before. In 1847 another step in the right direction was made, and the difference reduced to 14*s.* per load. In 1851 the differential duties ceased altogether, and the impost was established at 7*s* 6*d.* and 10*s.* per load, according to the description of the timber, without respect to the country from which it was imported. In 1860 the duty was reduced to 1*s.* for hewn, and 2*s.* for sawn timber per load, and in 1866 it was totally repealed, so that timber of any kind from any country is now admitted free of duty.

The quantity of timber of various kinds imported into the United Kingdom in 1886 was as follows:—

	Chiefly from	Quantity.	Value.
		Loads	£
Timber, hewn,	Russia, Sweden, Germany, & Brit. North America,	1,577,992	3,405,526
Timber, sawn or split, . .	Russia, Sweden, Norway, & Brit North America,	3,783,200	8,197,619
Staves, . . .	—	130,708	532,119
Mahogany, . .	—	47,857	395,406

It may here be remarked that timber is sold by the load, the cubic foot, the square foot, the foot run, the ton, the pound, or the number of pieces; but the greater portion is by the load. A load of unhewn timber is 40 cubic feet; of squared timber, 50 cubic feet; and of planks, 150 to 600 square feet, according as the thickness varies from 1 to 4 inches. Of a very usual kind of plank, 12 feet long 11 inches wide and 3 inches thick, eighteen make one load. The effect of trees on climate is treated of in the article FOREST. See also the article ARBORICULTURE.

TIMBER, PRESERVATION OF. Imperfect seasoning, by leaving in the pores of timber a large portion of the fermentable juice always found in recently felled trees, is one of the most important causes of its decay; therefore good seasoning is as essential in promoting the durability of wood as it is in lessening the tendency to those changes of form and bulk which so greatly increase the difficulties of the carpenter and joiner. [See DRY ROT.] The process of seasoning usually consists simply in the exposure of the timber to the action of air in a dry situation until the sap or vegetable juices shall have dried up so far as to offer no facility for the germination of the microscopic fungi which constitute various kinds of rot. To insure success the timber must be raised from the ground, so as to allow the circulation of air beneath it; and also, if exposure to rain be not entirely avoided, care must be taken to prevent the lodgment of moisture in any place where it would be likely to remain long.

The protecting power of metallic oxides, when applied to the surface of wood in the form of paint, is well known; and many schemes for the preservation of timber have been devised to act upon the same principle, which is that of excluding such external influences as might promote decay. To imperfectly-seasoned timber, however, such applications are worse than useless, because by filling up the pores they impede the natural drying of the vegetable juices, and therefore rather promote than check internal decay. Far more efficient than these are the numerous modes of protection which involve the impregnation of the timber with some antiseptic substance, or with such matters as, by preoccupying the pores, may render the reception and germination of destructive fungi mechanically impossible.

TIMBRE (quality of musical tone). See ACOUSTICS.

TIM'BREL, a musical instrument of the highest antiquity, the *tympanum leve* of the Roman poets and the *toph* of the Hebrew Scriptures, is, in the opinion of all writers of any authority, the same, in an almost unaltered state, as that now known in every part of Europe under the names of tabor, tambourine, &c.

TIMBUKTU' or **TIMBUCTOO**, a city of the Soudan in Africa, on the south border of the Sahara, about 7 miles north of Kabaro on the Niger, round which from old times an air of mystery has gathered as a great market of African trade. Only five Europeans have ever visited it, the last, Dr. Oscar-Lenry, in 1880. The town is much reduced in size, but it is fairly built of mud and clay houses, and has four large and three small mosques. It is a purely commercial town. About 5000 camel-loads of goods come to Timbuktu every year from the north by the two main routes of Morocco and Ghadames. The wares coming from the north are cloth, blue cotton, green Chinese tea, sugar, waxlights, dates and tobacco. The kola nut, which in the Soudan takes the place of tea, coffee, and cocoa, is also largely imported from the lands of the Sierra Leone coast and Ashantee. The exports to Europe, on the other hand, are ostrich feathers, gum, and some gold, as also ivory and negro slaves to the Northern African states. Timbuktu is especially an emporium for salt, which it receives from the beds of Taudeni, and sells to the people of the south. The population at the fullest time is estimated at 20,000.

TIME. The natural unit employed in our measures of time is the period of rotation of the earth upon its axis. This period is called the sidereal day, and it is equal to 23 hrs. 56 min. 4·091 secs. of ordinary mean solar time. The sidereal day, like the mean solar day, is subdivided into twenty-four hours, each hour into sixty minutes, each minute into sixty seconds. It may at first sight seem to introduce needless complexity into the subject to use one kind of time for astronomical purposes and another for ordinary civil purposes, but the distinction is eminently convenient. As in one sidereal day each star accomplishes a complete apparent circuit of the heavens, it follows that each star comes to the meridian day after day at the same sidereal time, subject only to certain minute variations which need not now be considered. The sidereal time at which an object culminates is, in fact, its right ascension, and this makes the use of astronomical time quite indispensable in the observatory. An astronomical clock is therefore rated to keep sidereal time, and gains 3 min. 56 sec. every day on a mean time clock. But for the ordinary purposes of daily life sidereal time would not answer. Ordinary time must be regulated by the sun, and custom has decreed that when the sun culminates (or to speak more precisely, when the *mean sun*, to be presently explained, culminates) our ordinary clocks should show noon, or 0 hrs. 0 min. 0 sec. But the time of culmination of the sun, as shown by a sidereal clock, would be different every day. The sun is moving from west to east among the stars, so that, compared with the stars, it comes on the meridian about four minutes later every day.

An apparent solar day is the interval between two consecutive transits of the centre of the sun across the meridian. This interval is not constant, some apparent solar days being about a minute longer than others. We therefore adopt a mean solar day, which is the average interval between two consecutive culminations. Suppose an imaginary sun moving uniformly round the equator in a period equal to the mean solar day and coinciding with the true sun at a certain initial shock. Then the true sun will always reach the meridian nearly at the same time as the mean sun, the interval between the two is the *equation of time*, and the culmination of the mean sun is the time of mean noon. The determination of mean time at the observatories is usually made by observation of the standard stars in the *Nautical Almanac*, which also gives the sidereal time at mean noon on the day in question. The observation of the star gives the error of the sidereal clock. The sidereal interval from noon is thus obtained, and by reducing this interval in the proportion of the length of the sidereal day to the mean solar day, the mean time interval from noon is obtained. At sea, where the fixed instruments of the observations are not attainable, the time is determined by the observations of the sun. The sextant enables the altitude of the sun over the horizon to be measured, and the moment when that altitude is greatest is the time of apparent noon, from which the mean noon is deduced by applying the equation of time.

The distribution of correct time from the observatories has of late years received much development. The most approved system at present in use is that where the standard mean time clock at the observatory despatches each second an electric current along a wire which is communicated to every one of the controlled clocks on the circuit. The pendulum of each controlled clock has for a bob a pair of horse shoe magnets, while fixed to the case of the clock, though passing between the pair of magnets, is a coil of wire through which the current passes each second. The controlled clocks are driven by a weight, wound in the ordinary manner, so that the only effect of the current is to control and not to drive. A very weak current is all that is required for this purpose. The mean time clock at Dunwich Observatory is provided with two batteries, each consisting of two Daniell's cells of the admirable Meidinger type, which after each charge lasts for a year or more without the slightest attention. The current travels in alternate seconds from each battery in reversed directions, and controls several clocks in Dublin, at a distance of 5 miles. For the regulation of the standard clock it is requisite to have more means of effecting small changes in its rate even without the necessity of stopping the clock. The simplest method of doing this is to have a shelf placed half way up the pendulum rod, and to place on this shelf small weights which can be altered as required. It will be best to determine by trial the weight necessary to cause an alteration in the rate of one second per diem, and then to have a series of weights made each of a specific number of seconds. A change from one weight to another can be effected in a moment without in the least deranging the movements of the clock. The correction is then propagated from the standard clock to the clocks in the circuit. In order to test the controlled clocks it is arranged that no current is sent the first second of each minute, so that by a galvanometer it can be seen at each controlled clock whether it is right or not. To test for the minutes it is desirable at a certain specified minute of the hour to have the current thrown off altogether, for perhaps twenty seconds.

TIME, in music, is sometimes applied to the *pace* at which a composition is rendered (as *andante*, *allegro*, &c.), but this is more properly called the TEMPO, and is spoken of under that heading. Time, in music, is correctly limited to the various groupings of accents in small recurring series, each series having one principal accent, and being called a measure (or bar), and the measures being marked off by bar lines. The principal accent of the measure is on that note which immediately follows the bar line, *i.e.* which "begins the bar" in the usual phrase.

Except for a few eccentricities of time, principally consisting of pieces with five-accent measures (*e.g.* a song in Gounod's "Mirella," the slow movement in Balfe's Violoncello Sonata, &c.), time is either duple or triple, and is expressed therefore by the figures 2, 4, 6, and 12 for duple time, 3 and 9 for triple time. The times described by 6, 9, and 12 are really respectively made up of 2, 3, and 4 groups of triplets, and they are therefore very frequently called "compound times." Other times are "simple times."

But it is not only necessary to mark the number of accents in a bar; it is also necessary to mark the values of the notes. For this purpose the semibreve is taken as filling a bar: the figures given above would mean that the bar should contain 2, 4, 6, or 12, and 3 or 9 semibreves respectively. Minims are represented by $\frac{1}{2}$, crotchets by $\frac{1}{4}$, quavers by $\frac{1}{8}$, and the whole time-signature thus takes the form of a fraction.

The most usual times are—$\frac{2}{4}$ (two crotchets in a bar), $\frac{4}{4}$ or common time, $\frac{6}{8}$ and $\frac{12}{8}$ for duple time ($\frac{6}{8}$ and $\frac{12}{8}$ being "compound duple time"), and $\frac{3}{4}$, $\frac{3}{8}$, and $\frac{9}{8}$ for triple time ($\frac{9}{8}$ being "compound triple time"). The time-signature is only put once, at the beginning of the piece, immediately after the key-signature: if a change of time occurs during the piece a double bar is drawn, and the new time-signature placed immediately after the double bar.

TIME BARGAINS, a term sometimes employed on the Stock Exchange to designate such bargains as are made for the monthly or bi monthly settlement or account; the term money-bargains being used for such transactions as are immediately settled for cash. In the London Stock Exchange the great bulk of the business is transacted for "the account," and when it is undesirable to close a bargain at the settlement, arrangements are usually made to continue it on to the next, by the payment of a rate and the difference that has arisen between the price of the original transaction and that which rules on the morning of contango-day. See also STOCK EXCHANGE.

TIME and **SPACE.** See SPACE AND TIME.

TIME, STANDARD; and **UNIVERSAL TIME.** In 1883 an international conference was held at Washington to discuss the question of adopting a "prime meridian" for universal use, and in connection therewith to settle on a uniform basis the various modes of time-reckoning in use in different countries. Hitherto nearly every country has had a "prime meridian" of its own. In English maps the longitude of every place is stated to be so many degrees east or west of Greenwich; in French maps the starting-point is Paris; in Germany it is Feris (or Ferro) Island, and so on. The conference decided that this anomaly should be abolished, and that longitude should be reckoned only from the meridian of Greenwich, and that it should count 180° east and 180° west; so that in future all maps will be constructed on this principle, and ships of every nation, meeting at sea, will find themselves in the same degree of longitude, instead of, apparently, so many degrees apart. But the mode of reckoning time as well as longitude differs in different countries, and a ship sailing from, say Hamburg, and another ship sailing on the same day from London, and meeting in the evening on the North Sea, would find a difference of fifty-four minutes between their chronometers. Each would have "standard time"—one that of England, the other that of Germany. Now, to understand what standard time is we must understand the general principles of time reckoning. The absolute "noon" at any place is the moment at which the sun reaches the highest point in the heavens, as viewed from that place, day after day. Thus the only places which have the same absolute noon are those which are on the same meridian. It is noon at Valencia in Spain at the same moment as at London, but noon at London is twenty-two minutes earlier than at Penzance, and seven minutes later than at Lowestoft. When railways were introduced it was found impossible to regulate the hours of the arrival and departure of trains according to each "local" noon, and so it was arranged that noon at Greenwich (or the site of the Royal Observatory) should be reckoned as noon in all parts of Great Britain. But owing to the orbital motion of the earth the absolute noon, as shown by the position of the sun in the heavens, is not the same every day, being for six months of the year earlier than the average and for six months later. The average of all these variations during the year forms the "mean" noon. By Greenwich mean time, thus fixed, all the clocks are regulated, instead of by the "local" absolute noon as shown by the sun. In the same way Paris mean time has been made the "standard" time in France, Berlin mean time in Germany, and so on. The Washington conference agreed that, for astronomical purposes, noon at Greenwich should be noon all the world over, and that, just as there is to be one universal "prime meridian" for calculating longitude, so there shall be one "standard time" reckoned for mean noon at that meridian. It further agreed that the day, instead of being divided into two portions of twelve hours each, should be divided into twenty-four hours, counting from midnight.

TIMO'LEON was a native of Corinth. His elder brother Timophanes, who had been elected general by the Corinthians, having usurped the supreme power in his native city, Timoleôn formed a plot against him, and Timophanes was killed. Soon after there arrived at Corinth

Dekadrachm of Syracuse in the British Museum—actual size (silver).

ambassadors from Syracuse soliciting the aid of the Corinthians. This was a favourable opportunity for the party hostile to Timoleon to get rid of his followers, while at the same time it opened to him a field of action in Sicily. He was very successful, and was making efforts to restore the prosperity of Syracuse by recalling those who had been in exile, and by inviting colonists from other parts of Sicily, when the Carthaginians sent a large force against him; but he was able to confine them to that part of Sicily which lies between the river Halycus and the western coast, B.C. 339.

Timoleon now directed all his efforts to the re-establishment of Syracuse, and to the improvement of the political constitution; and though he might easily have seized on the supreme power, he was true to his engagements, and honestly discharged the important duties which the Syracusans had confided to him. Syracuse and Sicily felt the benefit of his honest labour for many years after his death.

In the latter part of his life he became blind, and lived in retirement. He died in B.C. 337, and was buried in the Agora of Syracuse.

TIMON OF ATHENS, *the Misanthrope*, was a native of Attica. He lived during the Peloponnesian War (431–404 B.C.), and having been disappointed in the friendships he had formed, conceived a bitter hatred of all mankind. He lived almost entirely secluded from society, making an exception in favour of Alcibiades alone; and his eccentricities gave rise to numerous anecdotes. The comic poets ridiculed him in their comedies. His name has remained proverbial to designate a misanthrope down to the present day, and has been immortalized by the genius of Shakespeare ("Timon of Athens").

TIMOR' or **TIMUR'**, an island of the Malay Archipelago, separated on the west from the island of Ombai by Ombai Strait; washed north by the Banda Sea, and south by the Indian Ocean. Its length is about 250 miles, and its average breadth 35 miles. The area is 8820 square miles. A mountain range, which reaches to 12,000 feet in some points, traverses it in the direction of its length, clothed with rich woods; but there are many fine and fertile plains, yielding all the rich tropical products. The climate is very salubrious. The Dutch and Portuguese have several scattered settlements on the coasts. The south-western three-fourths of the island belong nominally to Holland, and form part of the residency of Timor; the north-eastern fourth, with the islet of Kambing off its north coast, forms now the only Portuguese possession in these seas. The chief Dutch settlement is at Koepang, on a fine bay at the south-west extremity of the island, and this is the capital of the residency. The exports are chiefly of sandal-wood, horses, wax, tortoise-shell, and edible birds'-nests. Papuan negroes inhabit the interior; Malays chiefly are found on the coasts. The population of the Dutch portion is about 900,000, and of the Portuguese portion 800,000.

TIMOR-LAUT or **TENIM'BER ISLANDS,** a group in the Malay Archipelago, of which the chief is Timor-laut. They are mostly coral islands, surrounded by reefs. They are sometimes visited by whalers. The natives are distinguished from those of the surrounding islands by their language, and also by their form; they are tall, well made, and have regular features. The men of the lower class go entirely naked, and the women have only a small piece of cloth around their loins.

The island of Timor laut is 78 miles in length and 21 in breadth. Its surface is mountainous and wooded. Larat has an area of 140 square miles, and a population of 2500. Further north are Vorbate, Maru, and Molo. On the west are Selu and Sejrah, and a multitude of smaller islands are scattered around. The total area is 3160 square miles, and the population 15,000. Cattle, goats, swine, fowls, birds, and fish are abundant.

TIMOTH'EOS, a poet and musician of Milêtos, was born about 450 B.C. He was warmly supported by Euripides in his large innovations in Greek music, and eventually became very popular in Greece as a musician. He is said, among other innovations, to have introduced the use of eleven strings for the lyre. These changes, however, exposed him to the censure of the poets of the old comedy at Athens, who charged him with corrupting the ancient poetry and music. He died in 357. He is not to be confused with that great flute player of Thebes whose strains had so moving an effect on Alexander the Great, as commemorated in Dryden's ode ("Alexander's Feast"). Dryden unwarrantably makes him use the lyre.

TIMOTH'EOS, the Athenian general, son of the great Konôn (Lat. *Conon*), was one of the most celebrated commanders of the age. We first hear of him as intrusted with command in 378 B.C., and from this time onward in Greece or in Asia he was constantly engaged. In 356 B.C. he was one of the commanders in an unsuccessful sea-fight; and being brought to trial two years later for this offence, was fined the enormous sum of one hundred talents (£25,000), contrary to all reason and justice. He died in exile soon afterwards, and the fine was ultimately reduced to ten talents, when it was paid by his son.

TIMOTHY, ST. (Gr. *Timotheos*, the God-fearing), a disciple of St. Paul, afterwards his companion in travel and in the work of the gospel, was the son of a Gentile father of whom nothing is known, and of a Jewish mother named Eunice, who adhered devoutly to her national religion. It is not clear from the narrative of the Acts of the Apostles whether Lystra or Derbe was the residence of the family at the time of the mission of St. Paul, but the mother and grandmother of Timothy became converts to Christianity, and when Timothy reached the years of manhood he was chosen by the church for the work of the ministry, and taken by St. Paul as a companion and assistant. As Timothy was the son of a Jewess, and had been trained in the Jewish religion, Paul circumcised him to prevent the cavils of the Jews, and henceforward we find him closely associated with the apostle up to the period of the imprisonment of the latter at Rome.

From the narrative of the Acts of the Apostles, and the references in the Epistles, we may learn that Timothy was a faithful, zealous, and self-denying Christian, and that he enjoyed in a large measure the confidence and affection of St. Paul, whose last recorded words express the earnest hope that he might see once more his companion and friend before his martyrdom. At this period Timothy had been left in charge of the important church at Ephesus, a position of great anxiety and difficulty, and here all authentic history concerning him comes to an end. Some old traditions assert that he continued to sustain the office of bishop of Ephesus until nearly the end of the first century, when he suffered martyrdom, being killed with stones and clubs while preaching against idolatry in the neighbourhood of the Temple of Diana. His supposed relics were removed to Constantinople with great pomp, in 356 A.D.

TIMOTHY, EPISTLES TO, two of the books of the New Testament which, with a third, the Epistle to Titus, form the group known as "the Pastoral Epistles." The First Epistle to Timothy appears to have two chief objects: first to counteract the false doctrines of certain Jewish teachers, and secondly to direct and encourage Timothy in the duties of his office, the directions extending to his personal conduct, to the conduct of public devotion, the appointment of church officers, the duties and behaviour of Christian women, and church administration in the treatment of offenders, of widows, of good elders and bad, of slaves, of the rich, with the duties of these several classes of persons. Along with these injunctions it also contains many personal references of the apostle, urgent and affectionate appeals to Timothy, and some solemn anticipations of the second coming of Christ. The epistle professes to be the work of St. Paul, and up to the present century its genuineness was never seriously questioned. It is reckoned among the Pauline Epistles in the Muratorian Canon and the Peshito Version, is accepted by Tertullian, Clement of Alexandria, and Irenaeus, and is placed by Eusebius among the books accepted by all. It was rejected by Marcion, Basilides, and other Gnostic teachers, but their objections were based upon doctrinal, and not upon critical grounds. In modern times J. C. Schmidt was the first to question the Pauline authorship of the epistle, and he was followed in this respect by Schleiermacher, Bauer, Meyer, De Wette, Ewald, and others, their objections being based upon admitted differences of style when compared with the unquestioned epistles, the difficulty of fitting in the references of the epistle with the record of the Acts, the advanced condition of church life which is referred to, and the doctrinal allusions, which are assumed to relate to a period a century at least later than the time of St. Paul. Against the attacks of these critics the Pauline authorship has been defended by Thiersch, Wieseler, Reuss, Huther, Bleek, and

others, while at a period earlier than this controversy many undesigned coincidences between the epistle and the Acts of the Apostles were pointed out by Paley in his "Horæ Paulinæ." It must be admitted that the microscopic scrutiny of the German critics has resulted in the discovery of certain difficulties not before observed, but on the other hand many of their criticisms are of an arbitrary, trivial, and capricious character, and most of them contain much unsupported assumption. The defenders of the authenticity of the epistle are not agreed as to the time when it was written, one theory being that it must be placed during the time spent in Macedonia after the tumult at Ephesus (Acts xx. 1), while another theory assigns it to the period between St. Paul's first and second imprisonments at Rome.

The Second Epistle to Timothy, which purports to be written by the Apostle Paul, then a prisoner expecting death, has for its immediate object the request to Timothy to come speedily to him, and it contains numerous personal references, many affectionate expressions of regard, and earnest exhortations to steadfastness, diligence, and patience, with suitable warnings and consolations. Like the first epistle it was almost universally accepted up to the present period, and like the first also it has been subjected to the attacks of the modern critics of the advanced school upon grounds similar to those already mentioned. Accepting with most conservative scholars the genuineness of the epistle, we have in it the last of the letters of St. Paul, and its references to his circumstances, feelings, and anticipations, invest it with profound interest for all students of the life and work of the great apostle of the Gentiles.

TIMOTHY GRASS or **CAT'S-TAIL GRASS** (*Phleum pratense*) is an important species of GRASSES belonging to the tribe Agrosteæ. It is a native of Britain and Northern Europe, and is very generally cultivated as fodder for cattle. It is a perennial, attaining a height of from 3 to 5 feet. The inflorescence is a close, cylindrical, spike-like panicle, several inches in length. It thrives in moist, rich soil, and is one of the earliest and most productive of our grasses. It is much relished by cattle.

TIM'PANI, the orchestral name (Italian) for DRUMS.

TIMUR'-I-LENG or **TAM'ERLANE,** one of the greatest Oriental conquerors, was born in 1335 at Kesh, a town to the S.E. of Samarcand. He could boast of descent from Genghis Khan by the female side. Until the age of twenty-seven Timur had not been peculiarly distinguished in arms. His first adventures were the efforts he made to restore the independence of his country, which had been invaded by the Kalmucks. In one of his earliest engagements he happened to receive a wound in the thigh, which resulted in lameness, and hence the name Tamerlane, a corruption by Europeans of the epithet Timur-i-leng, or "lame Timur." Triumphant over some rival chiefs, he was proclaimed ruler of Zagatai in 1369, and selected Samarcand for his capital. The crown of that kingdom was the first of fourteen that, before his death, encircled his victorious brow, though he never styled himself khan. All his life he dragged about with him a grand khan, whose subject he professed to be. Gradually extending his conquests, he conceived the bold and ambitious design of subjugating all the countries which had once obeyed his celebrated ancestor. During his conquest of Khorassan, the people of Sebsewar, one of its captured cities, revolted; and we are told that after retaking the place, Timur built 2000 of the inhabitants alive, one upon the other, until they formed a tower of human beings, and cemented each living layer to the next by mortar, as if they were bricks instead of men—an atrocity so execrable that it is incredible. By 1387 the principal part of Persia had fallen into his hands, and the work of devastation was fitly crowned by the storming of Ispahan, where 70,000 heads were laid at the feet of the victor, who ordered them to be piled up by his soldiers in the public places of the city. The war, which lasted from 1387 to 1396, ended in the conquest of the khanate of Kiptschak, the entire army of the Khan Toktamish being annihilated. Timur still continued to reside at Samarcand when not, as was most frequently the case, employed actively in the field; and it was to this capital that he transplanted the artists and scholars of the conquered countries; for the man was, in his own barbaric fashion, a patron of science and literature. By 1396 Timur had penetrated as far as Moscow. He next aimed at the subjugation of India. Under some pretext he declared war against Mahmud, who then reigned at Delhi, and in 1398 he led his Tartar hordes across the Indus, traversing the Punjab from north-west to south east, and spreading terror in every direction. The war with Bajazet ("Thunderbolt"), sultan of Asia Minor, was the last great incident in the life of Timur. After provoking Bajazet by threatening letters, he invaded his territories in 1402. The sultan was then besieging Constantinople; but hastily breaking up his camp before that city, he marched against the invading Mongols, who were attacking Angora in Asia Minor. Here, beginning on the 28th July of the year just named, Mongol and Tartar fought during three days and two nights, and 140,000 men were left dead upon the field. The Turks were utterly routed, and the wretched "Thunderbolt" was carried about inclosed in an iron cage till death released him in 1403. This story, it is right to say, is not confirmed by the Persian annalists. "From the Irtish and Volga to the Persian Gulf, and from the Ganges to Damascus and the Archipelago, Asia was in the hands of Timur;" yet age had not cooled the wild fervour of his ambition, and he was preparing for the invasion of China when the hand of death arrested his career. He died on his march towards China at Otrar on the Jaxartes, 1st April, 1405, leaving behind him a numerous offspring, whose descendants —at least in the case of the Great Moguls—reigned over different sections of his dominions for several centuries. No notice of this scourge of humanity would be complete without a reference to Marlowe's splendid two part drama "Tamburlaine." An excellent and cheap selection from Marlowe, including "Tamburlaine," was published in the Mermaid Series in 1887.

TIN (Lat. *stannum*, Fr. *étain*, Ger. *zinn*), the so-called Jupiter of the alchemists, is represented by the symbol Sn, and the atomic weight 59. It is a beautiful metal, of a bright silvery colour, with a tint of yellowish-blue, and a high polish. If viewed in such a manner as to exclude the light from its surface, it appears of a clear yellow colour. It is softer than gold, but harder than lead; is malleable, though imperfectly ductile. When beaten out into thin leaves it is termed *tinfoil*, but in its native state it possesses a crystalline structure. At a temperature of about 212° its ductility becomes much increased, and it may be drawn out into a wire of moderate tenacity, capable with a diameter of 0·17 of an inch to support a weight of 40 to 45 lbs. It acts as a conductor both of heat and electricity, and, when handled, exhales a peculiar odour. When bent it emits a peculiar cracking noise, termed the "cry of the tin," the *zinngeschrei* of the Germans. If bent rapidly backwards and forwards it grows hot, a circumstance due to the friction of its constituent crystals. It melts at 442°, and slightly contracts on consolidation. At a higher temperature it changes into the protoxide (SnO), and gives out a brilliant white light. At an ordinary temperature it does not readily tarnish on exposure to the air. Placed upon ignited charcoal, and subjected to the action of a current of oxygen gas, it enters into rapid combustion, and forms the peroxide (SnO_2). If an intensely heated globule of the metal be thrown upon a sheet of dark-coloured paper, it subdivides into minute particles, which burn very brilliantly and leave lines of white oxide. The specific gravity of tin is 7·29. It forms alloys with most of the other metals.

There are three oxides of tin: the protoxide or stannous

(SnO), the sesquioxide (Sn_2O_3), and the dioxide or stannic (SnO_2). The stannic oxide forms stannic and metastannic acids with water, which form salt with alkalies, earths, and metallic oxides. Muriatic acid dissolves tin as stannous chloride ($SnCl$), which is used by dyers and in laboratories as a reducing agent, by virtue of its strong affinity for oxygen and chlorine. Dilute sulphuric acid scarcely attacks tin; heating with concentrated sulphuric acid transforms it to stannous sulphate, setting free sulphurous acid; very dilute nitric acid dissolves it cold, without any escape of gas, ammonia being formed simultaneously with the stannous nitrate, and held as nitrate of ammonia in the solution. Concentrated nitric acid attacks tin violently, forming the insoluble metastannic oxide, which is the putty powder used in enamelling and in polishing plate. *Aqua regia* dissolves tin as stannic chloride ($SnCl_2$). Alkalies cause oxidation of tin, forming stannic acid, which unites with the alkaline bases. Thus, tin being heated in concentrated caustic soda solution, hydrogen is set free, and sodic stannate is formed. This is extensively used as a mordant, the basis of the tin prepared liquor of dyers and calico printers. Sulphuretted hydrogen does not attack massive tin at ordinary temperatures.

There are three sulphides of tin, of which the stannous or protosulphide may be obtained by heating sulphur and tin together: the second, sesquisulphide, by heating the first with additional sulphur; and the third, bisulphide, by a similar process. In the last case, the high temperature, which would otherwise decompose the bisulphide, must be kept down by adding to the ingredients volatile substances (mercury, sal ammoniac), which in escaping will absorb heat. This sulphide, thus produced, presents delicate golden or brownish-yellow scales, and is used as a bronze powder (mosaic gold, the *aurum musivum* or *mosaicum* of the alchemists). A mixture of stannous and stannic chloride, added to gold chloride in solution, precipitates a purple powder, supposed to be stannic oxide, coloured by metallic gold in fine particles, or a mixture or combination of the oxides of gold and tin. It is known as the purple of Cassius, and is used for colouring porcelain and glass, with which it is incorporated by fusion. The amalgam of tin and the alloys with lead and other metals are employed in the arts.

The native peroxide is the principal ore of tin, called *Tinstone* or *Cassiterite.* The finest is known as *grain-tin*, the common ores as *mine-tin.* It occurs abundantly in Cornwall, is also found in Germany, Bohemia, and Hungary; in Mexico and Chili; in Malacca; in the island of Banca; and in Queensland and Tasmania. Tin is detected in minerals by the metallic globule obtained when heating any compound of tin or charcoal before the blowpipe. In solution the purple precipitate formed with trichloride of gold is the most characteristic reaction. It is estimated usually as stannic oxide.

Metallurgy of Tin: Preparation of the Ore.—We have now to consider the mode in which tin is prepared for the smelter. The ore is first sorted, all impurities being cleansed by water, and the different qualities separated into heaps, according to the gangue or other minerals accompanying the tin; thus, ores containing copper and iron pyrites are classed differently from such as contain only earthy matters, and such as contain tungsten are set aside for special treatment. The several heaps are then reduced to a fine powder by the stamping mill—a machine consisting of a wooden shaft, connected with a water-wheel or steam-engine, in which a number of cams are arranged, that catch upon the lifting arms of a series of pestles heavily shod with iron, and secured in a strong wooden box to prevent the dispersion of the ore by the strokes of the pestles or stamps. Four stamping heads, averaging from $2\frac{1}{2}$ to $3\frac{1}{2}$ cwts. each, are worked in each box, and in the following order:—The pestle to the left, first; the extreme right, second; the right central, third; and the left central, last; and each pestle is so lifted that the strokes follow in succession. The revolving shaft makes about twenty revolutions per minute, and the ore which enters the box receives from 160 strokes to double this number to reduce it. A stream of water carries off the reduced ore to tanks or cisterns along narrow inclined planes. Here the ore, in consequence of its gravity varying in the ratio of its contents of metal, arranges itself into three kinds; the heaviest, which is the richest, resting on the upper part; a less rich ore in the middle; and the poorest or gangue parts, the tailings, at the lowest part. Very fine portions of the ore are carried off by the water in suspension to the slime pits, where it settles to the bottom, to be occasionally collected. The richest portion of the ore on the inclined plane is removed to the rectangular *buddle*, where it is washed under a regular stream of water, the ore being kept by a brush spread equally over the floor of the buddle. In this way the material is further purified, the richer ore remaining on the upper half, and a poorer product on the lower half of the table.

The richer ore is further purified in the *keeve*, or tossing tub, a stout wooden vat, well bound with iron hoops, capable of holding about 100 gallons. Here, through the action of the water, another separation of the ore takes place, according to the order of its gravity, the richer kinds being nearer the bottom of the tub, and forming distinct layers, of which the top is thrown away, the second submitted to another washing, and the lower is fit for the smelting furnace, or the roaster, and is called *tin witts.*

After some further cleansing operations, it remains to remove the sulphurous and arsenical compounds of the ore, which, for this purpose, is conveyed to the burning house, and roasted in reverberatory furnaces, or in a kind of roaster, called from its inventor, Brunton's Calciner. The reverberatories are of the usual form, having a bed about 9 feet long, 5 feet wide in the middle, and 4 feet at the back part, wherein is situated the working door. The charge, amounting to 10 or 12 cwts. of ore, is let down upon the bed through a hopper in the arch, and when roasted it is drawn out to an arched space beneath the bed by a small aperture inside the working door in the latter. The temperature supplied should not exceed a dull red heat, such as will be capable of dispelling the arsenic and sulphur without fusing the sulphurous compounds. The separation of the sulphur and arsenic is expedited by frequently rabbling the ore on the furnace bed; but under all circumstances, the time for each charge averages, according to the amount of impurities, from eight to twelve hours. The arsenical and sulphurous vapours pass from the furnace into a wide flue, which is divided into a series of compartments or chambers of varied dimensions, for the purpose of arresting the arsenic, and leading to a low chimney usually erected on some adjacent commanding eminence.

The tin has next to be purified by a process of "liquation," and afterwards by that of "poling." In the former the blocks are moderately heated in a reverberatory furnace till the tin melts and flows over into the refining basin, leaving on the furnace hearth a residuary alloy of tin with iron and other metals. This operation is continued until the refining basin contains about 5 tons, when the tin is ready for "poling." Billets of green wood are plunged into the melted metal, which, by throwing off its gas, produces a constant ebullition, and so causes a scum (chiefly oxide of tin) to rise to the surface, which is then easily removed; at the same time, all the densities and impurities fall to the bottom. After a certain continuance of agitation the bath is allowed to settle and cool, and the tin once more separates into layers according to its relative ratios of purity—the lowest being so much mixed with

other metals that it has to be resubmitted to the refining process. In like manner the residuum of the liquation process has its tin extracted and again refined.

Various improvements in the dressing of tin ore have of late years been introduced. Thus, the mineral wolfram, containing tungstate of iron and manganese, is removed by Mr. R. Oxland's method, which is thus described by Dr. Muspratt:—

"The tin ore, as finely dressed as possible, is mixed with as much soda ash or crude soda as will be sufficient to form an alkaline tungstate with the amount of tungstic acid which analysis shows the mineral contains. The mixture is then introduced into the bed of a reverberatory, and heated to a low redness, which temperature is sufficient to induce the combination of the alkali and the metallic acid body. When the operation is finished, as observed by the colour the mass assumes, and the consistency of a thick paste which it takes, it is raked out by an opening in the bed of the furnace into a receptacle beneath, whence it is taken and cast into vats filled with water, which dissolves out the tungstate of soda, leaving the other constituents of the ore untouched. By a judicious use of the water and a properly-constructed vat, the whole of the tungstate can be extracted with very few changes of water, and without diluting the solution to an inordinate degree. While this operation is progressing, the furnace is being charged with a further quantity of the mixture, which is spread out upon the sole, and left so with the furnace doors closed, till the alkali begins to melt and the mass emits a hissing sound, resulting from the expulsion of carbonic acid from the soda salt by the metallic acid. It is then slightly stirred; and when the preceding noise subsides, and the fore-mentioned indications are observed, the roasted mass is ready for drawing. Latterly, instead of carbonate of soda, or crude soda, sulphate of soda or *salt cake* has been substituted, both on account of its cheapness compared with soda ash, and of its answering all the required purposes in this respect, as well as the latter salt."

This process has long been in successful operation in Cornwall.

It appears from modern research that the loss of tin in the dressing of poor ores is much greater than when richer products are wrought, and yet, even in these, it amounts to about 25 per cent. of the whole quantity. This great loss is attributed to the large amount of "tailing stuff" produced, and the body of water employed in the course of working. Whilst the existing mode of tin dressing is practised, that loss can only be very slightly reduced. To obtain the whole of the 2 to 3 per cent. of binoxide of tin in the tin stuff, the dressing must be based upon chemical rather than mechanical principles. Considering that the loss of tin at present sustained in dressing 100 tons of stuff averages fully 50 to 60 lbs. worth, the recovery of this waste wou.. afford a scope for a partial outlay, by which to attain better and more profitable returns. Some mining companies have recently introduced crushing instead of stamping mills, and with considerable advantage; inasmuch as the former reduces the ore to a finer state of division, separates more of the gangue from the hard granules of tin, and thereby renders it more easily and freely separable by virtue of its gravity, than when this breaking up is imperfectly performed.

Smelting of Tin.—Few improvements were introduced into the smelting of tin up to the date of Charles I.'s reign. It seems to have been carried on in furnaces or hearths scooped out of the ground, and in which a mixture of block tin and charcoal was placed, the necessary degree of heat being doubtlessly maintained by the blast of rude bellows. Remains of such furnaces, popularly called *Jew houses*, are frequently met with in Devon and Cornwall. Early in Queen Anne's reign improved methods of smelting in blast furnaces, by means of fossil fuel, were patented by a Mr. Liddell. The invention of the reverberatory furnace soon after followed, and in this form of furnace tin ores have hitherto, but with slight modifications, been smelted. The charge of ore, which generally averages from 60 to 75 per cent. of metal, or, as estimated by the tin assayers and smelters, twelve to fifteen parts in twenty of ore, is mixed with 12 to 18 per cent. of powdered anthracite coal, and 20 to 25 cwts., or a little more, is taken for the working charge.

The following is the composition of the three qualities of tin obtained by the operations above described, according to Berthier's analysis:—

Centesimally.

	Ordinary Tin.	Common	Bad.
Tin,	99·76	98·64	95·00
Copper,	·24	1·16	3·00
Lead,	—	·20	1·50
Iron,	trace	trace	
Arsenic,	trace	trace	trace
Loss,			·50
	100·00	100·00	100·00

Tin Trade.—There can be no question that the Phœnicians visited England for the purpose of obtaining supplies of tin upwards of 1100 years before the Christian era. The Cassiterides, or Tin Islands, spoken of by Diodorus Siculus, were undoubtedly identical with the Scilly Islands and the western extremity of Cornwall. After the destruction of Carthage, the British tin trade fell into the hands of the Romans, and seems to have been carried on *via* the Isle of Wight, and through the interior of France to Marseilles. In fact, the route followed by the tin merchants may still be traced with a considerable degree of accuracy; and at Leap, in Hampshire, as antiquarians have shown, it crossed to Gurnard Bay, in the Isle of Wight, whence it proceeded over the Island of Puckaster, on its southern coast. But large quantities of this important metal were also obtained in the Iberian Peninsula.

In modern times the tin mines of Cornwall and Devon have been wrought with various degrees of energy and success. Queen Elizabeth brought over some German miners, by whom some of the processes were much improved; but during the Civil Wars of the Stuart period the mines were greatly neglected. In 1663 the exports of tin from England to all foreign countries amounted to 153 tons; in 1669, to 240 tons; in the three years of peace from 1698 to 1700, to an average of 1297 tons; but in the ten years of war, from 1700 to 1710, it declined to an average of 1094 tons. In these last ten years the annual purchase of the Dutch amounted to 300 tons, of the estimated value of £21,374. But the produce of the mines more than kept pace with the increased demand, the annual yield from 1720 to 1740 being about 2100 tons. The increase continued during the whole of the last half of the eighteenth century, and in the ten years ending 1800 the quantity annually produced averaged 3254 tons a year. In 1787 BANCA tin was first imported, and the price of the Cornish soon fell to 58*s.* the cwt. and would have declined still further if a new market had not been found for it in China, which is now, however, entirely supplied from Banca. During the first fifteen years of the nineteenth century the yield fell off; and for the five years ending with 1815 it was always considerably under 3000 tons per annum. From 1817 to 1837, however, there was again an increase, and the annual average yield was 4211 tons, the price being about 73*s.* per cwt.

The increase in the produce of British tin continued from 1837, and in the seven years from 1848 to 1855 it varied from 6000 to 7000 tons a year. In 1857 it reached

10,000 tons, and this amount, although occasionally equalled, has not been much exceeded in subsequent years, in consequence of the largely increased imports from abroad. In 1872 the average price of tin was £152 10s. per ton; in 1877 it had fallen to less than one-half. The exact quantity of metallic tin produced in 1885 was 9331 tons, valued at £833,803. On the other hand the imports in 1886 amounted to 483,506 cwts. valued at £2,327,974. The quantities exported in the same year were—British tin, 93,415 cwts., value £470,199; and foreign tin, 287,618 cwts., value £1,395,615.

Uses of Tin.—Tinfoil is used for coating the backs of mirrors, wrapping articles requiring to be kept from the air, lining boxes, &c. Tinfoil is prepared by rolling cast tin into plates, and beating and doubling as with gold foil, though by a simpler process. Tinfoil consisting of a surface of tin, with an interior of lead or tin-lead alloy, is prepared by placing a plate of lead or alloy in a mould slightly larger, casting tin around it, and rolling and hammering. Tin lined lead pipe for plumbers' use is made by setting a core of block-tin in the centre of a mass of melted lead, so that the more fusible tin is melted, but does not mix with the remainder of the bath, and then proceeding as in the ordinary manufacture of lead pipe.

Tin-plating is performed either by covering the metallic articles to be plated with melted tin, or by humid processes. The former method is chiefly confined to copper, iron, and zinc. Copper may be heated, cleaned with sal-ammoniac, sprinkled with resin to prevent oxidation, and then plated by pouring melted tin upon it, and spreading the tin with tow, a high temperature being maintained. The plating of sheet-iron, to form so-called "tin plate" or sheet tin, for domestic utensils, &c., is conducted as follows:—The thin sheets of iron are cleaned by immersion in dilute sulphuric acid, and subsequent rubbing with sand and water and washing, after which they are annealed by exposure to cherry heat for twelve hours in cast-iron boxes, tightly closed and luted. Imperfect or seriously oxidized plates are rejected. The accepted ones, which are purplish from a thin external film of oxide, are polished by being passed cold through rolls, then subjected to a second and less prolonged annealing, then sorted and cleansed again, and finally taken to the tinning apparatus. After cleansing they will quickly rust on exposure to air, but may be kept indefinitely without injury if immersed in pure water. The tinning apparatus comprises a series of long rectangular pots or tanks, with a fire under each. These tanks contain the liquid baths into which the plates are to be plunged. The operation comprises a series of immersions; first into melted grease, in which the plates are left till all moisture has evaporated; then successively into several baths of tin, each of which is purer than the preceding, so that the sheets acquire a coating first of alloy and finally of pure tin; then into melted grease again, in which the superfluous tin runs off, while the liquid grease prevents a too rapid cooling and consequent cracking of the surface. As the tin in the final tin bath becomes fouled by alloyed iron, it is removed to the preceding tin bath, and from this in turn to the first bath. After the final grease bath (tallow and palm oil), which anneals the plates, the edging of tin which usually forms around them is removed by dipping into melted cast iron, which melts it, so that a quick blow on the plate causes it to drop off. The plates are at last rubbed with bran and then with sheepskin to remove grease and dirt, sorted, packed in boxes, and marked to indicate size and quality. The sheet-iron for tin plates is rolled from the best charcoal or coke bar. Terne plates have, instead of tin, a coating of tin-lead alloy, containing from one-third to two-thirds lead. Iron may be coated with zinc first, and then very readily tinned by dipping into the fused metal, since tin and zinc unite with ease. Sheet zinc is tinned in the same way, but should not be left in the bath so long as to become alloyed with tin beyond the surface. Lead and its alloys may be tinned in like manner. The process above given for tinning iron is not applicable to cast iron, unless it has been decarbonized on the surface by heating in iron oxide, after the manner of the "annealing" practised in the manufacture of malleable castings.

The humid methods of plating tin upon various metals are numerous. Pins, which are made of brass wire, and other objects of brass or copper, are dipped into an aqueous solution, containing one part argol, two parts alum, and two parts salt, in which tin has been dissolved, or to which stannous chloride has been added. In this liquid they remain unaffected until brought into contact with metallic tin, whereby an electro-chemical action is caused, and all the objects connected directly or through one another with the metallic tin are immediately coated with tin reduced and precipitated from the solution. Boiling brass or copper objects, in contact with tin filings, in a solution of stannic oxide in caustic potash, is also an excellent way. Iron objects (nails, hooks and eyes, &c.) may be tinned, after suitable cleansing, in a bath of argal and stannous chloride, with the addition of zinc filings; or the bath may be composed of equal parts of the tin salt and common salt, dissolved in water, or of one part tin salt, one-fourth part sal-ammoniac, and one part common salt, dissolved in two parts nitric and four parts muriatic acid, diluted with water. In the latter liquid most metallic objects may be tinned by sufficiently prolonged immersion, copper or iron being kept in contact with a zinc wire during the process. Zinc is most easily tinned.

TIN STONE. See CASSITERITE.

TIN'AMOU (Tinamidæ) is a family of birds, formerly considered as belonging to the order GALLINÆ (game birds), but now generally advanced to the position of a distinct order, Crypturi, on account of some resemblances in the bones of the skull to the order Struthiones. The tinamous have a thick body, a small head, and the tail small and often concealed by the coverts. The bill is slender and a little shorter than the head, either nearly straight or slightly curved throughout, and usually rather suddenly hooked at the tip. The wings are short, rounded, and concave, indicating but small powers of flight. The tarsi are elongated, scutellated in front, reticulated on the sides, and naked quite up to the articulation; the anterior toes are rather long, and the posterior ones very short, and incapable of being applied to the ground.

The birds of this family are all inhabitants of South America, where they are called *Ynambus* by the Indians, and partridges or quails by the Spanish colonists, according to their size. They reside principally in the open fields, but some frequent the vicinity of woods, roosting at night upon the lower branches of the trees to avoid the attacks of animals of prey. Although they run very rapidly on the ground they appear to become so stupefied with fear at the approach of danger that they seldom seek safety by this means or by their somewhat heavy and laborious flight; and thus are easily knocked down with a stick, or captured by means of a running noose made of an ostrich feather fastened to the end of a stick. The eggs, about seven in number, are generally deposited upon the ground in the midst of a tuft of herbage; they are smooth and very glossy, sometimes deep purplish, and sometimes bluish-green. The food of these birds consists partly of insects and worms and partly of grain. They are highly esteemed as food.

The Great Tinamou (*Tinamus* or *Crypturus brasiliensis*), which is about 18 inches in length, is an inhabitant of Cayenne and Brazil, where it resides in the woods. Its general colour is olive, spotted with black on the back and tail; the crown of the head is reddish, and the primary quills ashy gray.

The Tataupa (*Tinamus* or *Crypturus tataupa*) is a much smaller species than the preceding, measuring only about 9 inches in length. It has the head, neck, and lower surface as far as the legs lead-gray, the throat white, the upper surface brown, and the rump black, with a white margin to each feather. The bill is bright red, and the legs purplish. This species inhabits the same regions as the preceding species, but prefers the open country to the forests. Its shyness is so great that when kept in captivity it will not come out of its place of concealment, even to feed, when anybody is in sight.

The Spotted Tinamou (*Nothura maculosa*), a native of Brazil and Paraguay, resembles the quails in its habits, whence it and others of the same genus have been termed American quails. It is abundant wherever the rough paja-grass or thistles afford any cover, and also frequents fields of maize and other cereals. Near Buenos Ayres it is shot in great numbers for the table.

The Crested Tinamou (*Calodromas elegans*) is a rather large bird, distinguished from all the preceding species of this family by its possession of an elongated crest depending from the back of the head. It inhabits the pampas of Buenos Ayres, and is described as being scarcely able to fly. Its eggs are large and of a brilliant green colour. Its note is a loud and often repeated whistle.

TINC'TOR, JEAN (*Tinctorius*), cantor to Ferdinand of Aragon, king of Naples, was born at Nivelle in Brabant about the year 1450, and died at Naples in 1520. He was the author of many treatises on music, and of the first musical dictionary that ever was compiled.

TINC'TURES are solutions of the active principles of vegetable, animal, or mineral medicines in certain solvents. From possessing more or less of colour they have obtained this name, and they are distinguished according to the solvent employed. By far the greater number are prepared with alcohol more or less dilute, these being termed *alcoholic tinctures*, or more generally simply *tinctures*; when sulphuric ether is used they are termed *etherial tinctures*. Ammonia is sometimes conjoined, and the proceeds termed an *ammoniated tincture*. Formerly some tinctures were called *essences*, from the term *esse*, it being thought that they contained only the purer or more refined portion, the alcohol, leaving all the baser principles, such as the starch, gum, woody fibre, &c., undissolved, a still higher degree of purity being represented by the term *quintessence*, but both terms have now fallen into disuse. *Elixirs* differ only from being of a greater consistence; they are not unfrequently turbid from the extractive matter suspended in them. Tinctures are further distinguished into *simple* and *compound*; simple, when one substance only is submitted to the solvent, compound when two or more are. They are usually prepared by reducing the solid ingredients to small fragments, coarse powder, or fine powder, macerating them for seven days or longer in proof spirit or rectified spirit, straining the solution, and finally expressing the residuum strongly to obtain what fluid is still retained in the mass. Displacement or percolation is also largely employed in the preparation of fluid extracts as well as of tinctures, and consists in allowing the fluid employed to filter slowly through the powdered drug, the lower layer of fluid, containing a large portion of the soluble constituents, being constantly drawn off, and its place supplied by fresh strata from above. This process is in most cases much more rapid than maceration. Tinctures are in many cases better clarified by repose than by filtration, as in the latter case a considerable portion is retained by the filtering medium and lost by evaporation.

TIN'DAL, MATTHEW, an English author who held a distinguished place among the deists of the eighteenth century, was the son of the Rev. John Tindal, of Beer-Ferries, in Devonshire, where he was born about 1657. He was educated at Oxford, took the degree of bachelor in 1676, and soon afterwards was elected to a law fellowship at All Souls, which he retained through life. He was created LL.D. in 1685, soon after which he became a Roman Catholic, but returned to the Church of England just before the revolution of 1688. After the Revolution, of which he was a zealous partisan, he became an advocate, sat frequently as judge in the Court of Delegates, and for his services in this capacity he had a pension of £200 a year granted to him by the crown. In 1706 he published an 8vo volume entitled "The Rights of the Christian Church asserted against the Romish and all other priests who claim an independent power over it" in opposition to High Church principles. This was well received on the Continent as a defence of Protestantism, but in England it answered the author's expectation that it "would make the clergy mad," and it was greeted with an immense number of criticisms and "replies." During the controversy he published two defences, which he reprinted in 1709, with essays on obedience and the law of nations, the liberty of the press, and the rights of mankind in matters of religion. In 1710 he attacked the party of Dr. Sacheverell in a pamphlet entitled "New High Church termed Old Presbyterian," but the House of Commons on one day, 24th March, 1710, condemned Sacheverell's sermons to be burned, and the next impartially ordered Tindal's "Rights of the Christian Church" and the second edition of his Defences to be committed to the flames at the same time. The most important work of Tindal's, however, was the celebrated treatise entitled "Christianity as old as the Creation, or the Gospel a Republication of the Religion of Nature," which appeared in 1730, in a 4to volume, the author then having nearly reached the age of seventy three. The object of this able work was, without an express denial of Christianity, to contend that there is nothing more in that religion, properly understood, than what the human reason is quite capable of discovering by itself, and by implication to deny that any special revelation has ever been made by the Deity to man. The book excited a great sensation, and Waterland, James Foster, Conybeare, Leland, Chapman, and others wrote replies to it. Tindal died 16th August, 1733.

TINDER, a material used for speedy ignition, commonly made of half-burned linen, and made to catch the sparks caused by clashing a piece of steel against a flint. This cumbrous and imperfect mode of procuring light was in general vogue before the introduction of lucifer matches; an invention which, insignificant as it seems, has largely promoted domestic comfort. Wood, when partially decayed, especially that of willow trees, supplies a kind of tinder.

TINE'IDÆ. See MOTHS.

TIN'GI is a Brazilian name for *Magonia glabrata*, a tree belonging to the order SAPINDACEÆ. It occupies extensive tracts of land in Brazil to the exclusion of other trees. It grows to a height of 30 or 40 feet. An infusion of the bark of the root is used by the natives for poisoning fish, while that of the stem is used in a similar way for curing ulcers or the sores on horses caused by the stings of insects. The seeds boiled with tallow form a kind of soap, which is used for washing clothes.

TINNEVEL'LI (*Tirunelveli*), a British district in the presidency of Madras, lying between 8° 9′ and 9° 56′ N. lat., and between 77° 16′ and 78° 27′ E. lon. The area is 5176 square miles, and the population 1,750,000. Tinnevelli occupies the extreme southern and eastern part of the Indian peninsula. The Ghats divide it from the native State of Travancore. The coast-line extends from Vembar nearly to Cape Comorin (the most southern point of India), 95 miles. The greatest length of the district is, from north to south, 122 miles; and the greatest breadth, from east to west, 74 miles.

Roughly speaking, Tinnevelli is a large plain (of an average elevation of 200 feet) sloping to the east, as may

be inferred from the general direction of its rivers. It is, in fact, made up of their drainage basins. Along the western boundary, the mountains rise from the plain to a height of above 4000 feet, but they send out no spurs running into the district, nor are there any isolated hills, and the face of the country is but slightly undulating.

Tinnevelli is a fertile district, and ordinarily enjoys good seasons. The chief crops are rice, spiked millet or *kambu* (*Panicum spicatum*), *chinah* (*Panicum milliare*), and oil-seeds. Tinnevelli is also one of the four great cotton districts of Madras. The palmyra palm flourishes in the almost rainless tracts of red sandy soil to the south.

Tinnevelli, lying immediately under the Southern Ghats, receives very little of the rainfall of the south-west monsoon, though parts of it are watered by streams which rise in the hills. The rainfall on the hills dividing Tennevelli from Travancore is probably 200 inches a year. Throughout the district the average rainfall is only 21·79 inches. The mean temperature of Tinnevelli town is 85° Fahr. During December and January the temperature falls under 70° at night. The hottest month is April. Kuttalam (Courtallum) is the sanatorium of the district. Tinnevelli is not reckoned unhealthy.

It was on the Tinnevelli coast that St. Francis Xavier, in 1542, after a short stay at Goa, began his work as apostle of the Indies. The Paravars, then as now a fishing caste, had received Portuguese protection against the Mohammedans, who oppressed them; and many of them had become Christians. St. Francis completed the work, and since then all the Paravars have called themselves his children. They are spread along the coasts of Tinnevelli, Madura, and Ceylon. Tuticorin is their chief town. We read of the martyrdom, in 1549, at Punnaikayal, of Father Antonio Criminale, the proto-martyr of the Society of Jesus. Many of the letters of St. Francis Xavier were written from Tuticorin and other places in the neighbourhood. In 1759, Portugal suppressed the Society of Jesus in its dominions, and imprisoned all its members. The Jesuits on the Eastern missions were on various pretexts brought within reach of Portuguese officials. They were summoned to Goa and other places, and there seized and imprisoned. Those who remained in the missions were deprived of all aid, communication with Europe was rendered difficult, and the supply of priests cut off. The general suppression of the Society of Jesus in 1773, the French Revolution in 1789, and other European troubles still further injured the missions. Till 1837, Tinnevelli had only a few priests from Goa, and in the absence of priests the number of Catholics declined. In 1837 Tinnevelli with other districts was intrusted to French Jesuits, and since that time the mission has made steady progress. Protestant missionaries first visited Tinnevelli towards the close of the last century, and there are now several flourishing stations.

Tinnevelli (*Tirunelveli*), the chief town of Tinnevelli district, is situated 1½ mile from the left bank of the Tambraparni. It is the largest town in the district, but the administrative headquarters are on the other side of the Tamn River, at Palamcotta, 2½ miles distant. When the district was subject to the Nayakkans of Madura, their governor, who was a very high official, lived in great state at Tinnevelli. About 1560 Visvanatha, the founder of the Nayakkan dynasty of Madura, rebuilt the town, and erected many temples, &c. Ferguson ("History of Indian Architecture") cites the great Siva temple as giving a good general idea of the arrangement of large Dravidian temples, and as "having the advantage of having been built on one plan at one time, without subsequent alteration or change." It is a double temple. The whole inclosure measures 508 by 756 feet. Like some other large temples, it contains a thousand-pillared portico. The Hindu Anglo-vernacular School is the most important school in the district. Tinnevelli is the terminus of a branch of the South Indian Railway. The town is notable as an active centre of Protestant missions in South India, and is the see of a bishop. The population is 20,000.

TIN'NITUS AU'RIUM, ringing in the ears, may arise from many different conditions. It is sometimes due to an unnatural state of the circulation in some part of the ear, the movement of the blood producing a vibration of the nerve which the mind does not distinguish from that produced by sonorous vibrations of the air. But most frequently the sensation is due to some disordered state of the auditory nerve, and is entirely subjective. It is thus perceived in some diseases of the brain, in nervous persons, and in those who are much debilitated, and is a common sign of organic disease of the auditory nerve itself.

TIN'TERN ABBEY, in Monmouthshire, is situated on the finely wooded bank of the Wye, about 10 miles south-east of Monmouth. It was founded for Cistercian monks by Walter de Clare, in 1131, and dedicated to St. Mary, but not completed until 1268, when mass was first performed within its stately walls. Nearly the whole of the building, except the tower, remains, and is a fine specimen of the Early English and Early Decorated architecture. The scenery surrounding it inspired one of Wordsworth's noblest poems, entitled "Lines composed a few miles above Tintern Abbey, on revisiting the Banks of the Wye."

TINTORET'TO, JACOPO ROBUSTI, one of the greatest of the Venetian painters. He was commonly called Il Tintoretto from the trade of his father, who was a dyer. He was born at Venice in 1512, and for a few days enjoyed the instruction of Titian; but for some cause not properly explained, he suddenly ceased to visit the studio of that great painter. He then determined to teach himself; he studied casts from the antique and after Michelangelo, and professed to endeavour to combine the drawing of Michelangelo with the colouring of Titian, writing on the wall of his studio, "Il disegno di Michelangelo ed il colore di Tiziano;" he comprised anatomy among his studies. Though a coarse and careless painter, Tintoretto was a master of prodigious powers. His execution was the boldest and the quickest, and his canvases were the largest. He acquired the nickname of Il Furioso, such was the energy of his style. Among his many great works the most remarkable are—the "Crucifixion," in the Scuola di San Rocco; the "Miracle of the Slave," in the Academy at Venice; and the "Marriage at Cana," in the Church of Santa Maria della Salute. To all of these three he put his name, and they are said to be the only pictures he ever signed. His largest work is the "Paradise," covering one wall of the grand saloon in the Doge's palace: it is 74 feet wide by 34 high. Tintoretto died at Venice on the 31st of May, 1594. He lost, in 1590, his daughter Marietta, who was an excellent portrait painter, and whom he greatly loved; she was only thirty years of age. He had a son also, Domenico, who was a painter; he died in 1637, aged seventy five. The value set on this painter's work by the art critic Ruskin is excessive; he has several times spoken of his life as devoted to the glorification of Tintoret.

TIN'VILLE, FOUQUIER. See Fouquier Tinville.

TIPPERA'RY, an inland county of the province of Munster in Ireland. It is bounded N.E. by King's County and Queen's County, E. by Kilkenny, S.E. and S. by Waterford, S.W. by Cork, W. by Limerick and Clare, and N.W. by Galway, from which, as well as from Clare, it is separated by the Shannon and Lough Derg. The greatest length from N. to S. is 70 miles, and the breadth 40 miles. The area is 1659 square miles, or 1,061,731 acres. The population in 1841 was 435,553; in 1881 it was 199,612. Nearly all are Roman Catholics.

Surface and Geology.—The Knockmeledown Mountains

on the south border of the county, rise to the height of 2700 feet above the level of the sea, and are situated in a table land of clay-slate, surmounted and bordered on the flanks by sandstone. This area of clay-slate is surrounded by floetz limestone on the north, west, and south. The tract on the north separates the Knockmeledown Mountains from the Galtees, of which latter the principal summits (3000 feet high) are in this county. The general direction of these two ranges is nearly east and west. The intermediate limestone plain or valley is watered by the Tar, flowing eastward into the Suir, and the Funcheon, flowing westward into the Blackwater. North of the Galtees, from which they are separated by a narrow valley (the Glen of Aherlow), rise the Slievh-na-Muck Mountains, which form a subordinate and lower range, and have the same general direction of east and west. Both the Galtees and the Slievh-na-Muck are composed wholly of sandstone.

In the centre is another important range. It commences in Limerick north of the little river Mulkerne or Bilboa, which joins the Shannon a short distance above the town of Limerick. At this extremity the chain is called the Doon Mountains; but as it extends north-east into Tipperary, the most elevated summits are known as the Bilboa and Keeper Mountains (the latter 2100 feet high) and the Devil's Bit. It crosses the county of Tipperary in a north-eastern direction, becoming narrower as it advances, and separates Queen's County and King's County from each other, being there known under the designation of the Slievh Bloom. The geological character of these hills is also similar to those already spoken of; Keeper and Bilboa, and the adjacent parts of the range, consist of clay-slate flanked by sandstone.

Near the lower part of Lough Derg are the Arra Mountains, a group occupying a small part of Tipperary on the western side, and extending across the Shannon into Clare (where they are known by the name of Slievh Bernagh): they also consist partly of clay-slate and partly of sandstone.

The level districts of this county form part of the great central plain of Ireland, and include portions of the great Bog of Allen.

The coal-field of Killenaule extends about 18 miles in length from north-east to south-west, from near the river Nore to the neighbourhood of Cashel, and is about 6 miles in breadth, being partly in Tipperary and partly in Kilkenny. It forms a low range of hills, placed upon the floetz limestone. The coal is of the anthracite kind. Copper and lead are also obtained in this county; the principal mines of the former being at Hollyford, and of the latter at Shallee. The lead is rather rich in silver. There is a good supply of excellent fire-clay; zinc in large quantities has lately been discovered at Silvermines; and valuable slates are extensively quarried near Killaloe.

The principal bogs are in the eastern and central part of the county: one continuous line extending from near the border of the coal-field at Killenaule to the south-eastern foot of the central range of hills at Roscrea, a distance of nearly 30 miles. There are smaller detached bogs westward of this, and some in the north.

The greater part of Tipperary is comprehended in the basin of the Barrow and the Suir, two rivers which unite in Waterford Harbour. A small portion on the eastern border is drained by the Minster, or King's River, an affluent of the Nore, which itself is a tributary of the Barrow. The Nore rises in the county, but its course is chiefly in Kilkenny. The Suir has its source north of Templemore, on the south-eastern slope of the mountains that there cross the county, and flows by Thurles, Golden, and Cahir, to the junction of the little river Nier: afterwards it runs along the borders of Tipperary and Waterford, first north, and then west by Clonmel and Carrick, below which it quits the county altogether. Its course in Tipperary may be estimated at about 76 miles; and it is navigable by large barges up to Clonmel. It receives a number of tributaries, most of them small.

The portion of the county which lies north-west from the central chain of mountains (the Keeper, Bilboa, and Devil's Bit), belongs to the basin of the Shannon. That river itself, and Loch Derg, through which it flows, skirt the north-western border for about 45 miles, throughout the whole of which it is navigable.

There are no lakes of importance in the county, and no navigable canals.

With the exception of the mountain ranges and bogs already noticed, Tipperary consists principally of extensive plains of rich pasture land on a calcareous subsoil. There are some very large estates; generally, however, farms are small. Formerly wheat was grown very extensively, but it is now being superseded by dairy farming and the rearing of cattle. Butter is exported in large quantities.

The woollen trade, which formerly flourished in the county, became extinct for some years, but has been revived at Carrick-on-Suir. The occupations of the inhabitants are, however, almost wholly agricultural. The county is intersected by the Great Southern and Western, with several branches, and the Limerick and Waterford railways.

The county is within the Cork or south-western military district, and is divided into twelve baronies and 193 parishes, in the dioceses of Cashel, Emly, Killaloe, and Lismore. It is in the Leinster circuit. Tipperary sends four representatives to Parliament.

History.—The Coriondi (Gr. *Koriondoi*) and the Udiæ, or rather Uodiæ (Gr. *Ouodiai*), of Ptolemy, occupied this county and the adjacent ones to the west and south-west.

In the English invasion Henry II., in 1172, summoned an assembly of the Irish prelates and princes at Cashel, where the sovereignty of the English king was recognized, and various regulations made, increasing the power of the clergy, and more completely assimilating the practices of the Irish Church to those of the Church of Rome. Tipperary, or part of it at least, seems to have remained under the dominion of Donald, of the sept of O'Brien, native prince of Thomond and Ormond, subject to the nominal sovereignty of the English king. In 1185, while John was in Ireland, sent over by his father as lord of the island, the Anglo-Normans erected castles at Tipperary and Ardfinnan. Donald died in 1194. The oldest part of the present cathedral of Cashel was built by him. Tipperary appears to have passed in the course of a few years afterwards into the hands of the Anglo-Normans, as it was one of the counties erected by King John in 1210, during his expedition to Ireland, at the head of a considerable army.

In the great Civil War in 1642, Clonmel, Cashel, Carrick-on-Suir, Fethard, and all the other towns in Tipperary, were seized by the insurgents, or, as they were termed, the Confederates, almost at the first outbreak in the central and southern provinces. At Cashel and Fethard there were some murders committed. The Earl of Inchiquin, who commanded in Munster for the Parliament, invaded the county in 1647, took Cahir by capitulation, and stormed Cashel, where he mercilessly slaughtered twenty priests and an unresisting multitude who had taken shelter in the cathedral. He levied contributions on all the neighbourhood, and was prevented from taking Clonmel only by want of provisions. When Cromwell invaded Ireland in 1649, and was opposed by the Royalists and Confederates, now united under the Earl of Ormond (to whom Lord Inchiquin, shocked at the execution of the king, had joined himself), a detachment from his army took Carrick-on-Suir, where the Protector himself crossed the river to besiege Waterford. A body of Royalists under Lords Inchiquin and Taafe, attempting to retake Carrick, was repulsed with severe loss. Ormond, with the main body of his army, was about this time near Clonmel watching Cromwell, whom sickness,

and the approach of winter, obliged to raise the siege of Waterford. About the latter end of February, 1650, Cromwell opened the campaign by taking Cahir, Cashel, Fethard, Clogheen, and other places in Tipperary or the adjacent counties; and in the course of the following April laid siege to Clonmel. This siege cost him more trouble and loss than anything else in his Irish expedition; upwards of 2000 men were killed in a fruitless assault. However, at the end of two months the place was obliged to surrender for want of ammunition. The garrison had previously withdrawn to Waterford without Cromwell's knowledge, and the townsmen obtained good conditions, as he supposed the garrison was still there. In 1651 Ireton, who was then general-in-chief for the Parliament, concentrated his army at Cashel, and marched to the bank of the Shannon, over which he forced a passage at Killaloe. On the restoration of royalty in Ireland, which rather preceded the same event in England, Clonmel was one of the towns occupied by the Royalists.

TIPPERARY, a market-town in the above county, with a station in the town about 3 miles from the Limerick Junction Station, 20 miles W.N.W. from Clonmel, and 110 miles south-west from Dublin by the Great Southern and Western Railway, stands near the little river Arra, which flows into the Suir. It is agreeably situated in a fine undulating country, and within a few miles of a beautiful range of hills, called the Slievh-na-Muck, which divide the counties of Tipperary and Limerick. As there is no town westward nearer than Limerick (23 miles distant), Tipperary has a good retail inland trade, and its daily butter market is now next in importance to that of Cork. Several of the houses are well built and of handsome appearance; many old buildings have been taken down and new ones erected in their place, so that the town has a neat and thriving appearance. The church is a handsome modern structure; there are Roman Catholic, Presbyterian, and Methodist chapels—the first-named a handsome Gothic edifice, with a tower 156 feet high, and painted glass windows. The town also contains some remains of an Augustinian monastery, chiefly consisting of an arched gateway; a corn and provision market, a large endowed school, barracks, a dispensary, and a fever hospital. The population in 1881 was 7274.

TIPPLING ACT. By 14 Geo. II. c. 40, s. 12 (commonly called the "Tippling Act") no action can be maintained for any debt on account of spirituous liquors, unless the debt be *bona fide* contracted at one time to the amount of £1 and upwards. The policy of this Act is to prevent the getting credit for small quantities of liquor and the marking up of "scores." The Act is modified by 25 & 26 Vict. c. 38 (1862), so as to exempt therefrom "spirituous liquors sold to be consumed elsewhere than on the premises where sold, and delivered at the residence of the purchaser thereof, in quantities not less at any one time than a reputed quart." By the amended County Court Act, which came into operation on the 1st of January, 1868, the provisions of the Tippling Act are extended to all sales of ale, porter, beer, cider, or perry consumed on the premises where sold or supplied, or in respect of any money or goods lent or supplied, or of any security given for, in, or towards the obtaining of any such ale, porter, beer, cider, or perry.

TIP'TON or **TIBBINGTON,** a town of England, in the county of Stafford, 3 miles south-west from Wednesbury, 8 north-west of Birmingham, and 121½ from London by the North-western Railway, is situated in the centre of the South Staffordshire iron and coal district. Its present size and importance are quite modern, and have arisen from the rapid extension of the iron manufacture. The articles made consist of the heaviest kinds of iron goods, such as railway materials, anchors, &c. There are also slitting and rolling mills, firebrick and cement works, and extensive stone quarries, which yield the well-known "Rowley rag." Several churches have been built, and there are numerous dissenting chapels and schools. The population of the parish (which includes some neighbouring villages) in 1881 was 30,013.

TI'PU SULTAN ("Tiger King") or *Tippoo Sahib*, the last independent sovereign of Mysore, born in 1749, and killed at Seringapatam 4th May, 1799. He was the son of Hyder Ali, and was first known by the appellation of Feth Ali Khan. He distinguished himself in the war against the English, and succeeded his father 7th December, 1782. He at once gave a new impulse to the war, took Bednore and other cities, and concluded a peace 11th March, 1784, on advantageous terms. He then assumed the titles of Sultan and Padishah, and subdued the Nairs of Malabar, carrying off from that province, it is said, 70,000 Christians, and forcing 100,000 Hindus to become Mohammedans. Under a flimsy pretext, in December, 1789, he broke the treaty with the English by invading the territory of their ally, the Rajah of Travancore. The English in turn invaded Mysore, took several of his strongholds, were joined by the Marhattas and the Subahdar of the Deccan, and, under Cornwallis and Abercromby, besieged him in Seringapatam, his capital. In March, 1792, Tipu was forced to conclude peace, agreeing to pay within a year 33,000,000 rupees, to give up to the allies nearly half of his dominions, and to deliver two of his sons as hostages. The Earl of Mornington (afterwards Marquis Wellesley), then governor-general of India, subsequently discovered that he was engaged in intrigues with the French and making preparations for war, and in February, 1799, on his refusal to desist from arming his subjects, gave orders for the invasion of Mysore. Generals Stuart and Harris defeated the Mysoreans in two encounters at Sidasir and Malaveli; and the sultan himself was obliged to take refuge in Seringapatam, at the storming of which by General Baird he was killed.

TIREE'. See TYREE.

TIRE'SIAS. See TEIRESIAS.

TIR'LEMONT, a town of Belgium, in the province of South Brabant, 26 miles south-east of Brussels. Its walls are about 8 miles round, and its market-place is very large. It has busy manufactures of cloth and machinery, and its Church of St. Germain dates from the ninth century. The population is about 14,000. Tirlemont was the scene of a defeat of the Austrians by the French in 1793.

TIRNO'VA, a town of Bulgaria, the residence of the Bulgarian kings before the Turkish conquest, stands in a situation at once bold, dangerous, and picturesque, surrounded by mountains on the Yanbra, 60 miles S.S.W. of Rustchuk. The town has some silk and dyeing manufactures, and extensive distilleries and numerous churches. The population is 11,474.

TI'RO, MARCUS TULLIUS, was a slave of Cicero. He was of such immense assistance as amanuensis, &c., and was a man of such large culture, that Cicero made him his friend and gave him his liberty. He took the name of Marcus Tullius according to the usual custom. It is to Tiro that we owe the remarkable quantity of Cicero's works preserved, and their admirable correctness. Tiro lived to the age of 100 on a little farm he bought after the death of Cicero.

The word *tiro* meant in Latin a beginner, and is very commonly used in English in that sense. There is no possible defence for the frequent misspelling *tyro*.

TIRO'NIAN NOTES, the shorthand of Roman antiquity, said to have been introduced into Rome by TIRO; it consists of arbitrary signs, substituted for words and phrases, still common in marginal addenda.

TIRUVAL'LUVAR, the greatest poet of the Tamil literature of India, was a weaver of Mayilapur, and developed into one of the greatest geniuses of the world, and the venerated sage and lawgiver of the 10,000,000 of Tamil people living between the Central and Southern

Karnatic; but neither to the poet nor to his one great work has fate granted a name. Tiruvalluva-Nayanar is not his name, only his title; its meaning being "sacred devotee, priest, or soothsayer of the Parraya (or Pariah) caste," while *Kural* means anything short, and is properly the name of the couplet used in this work. Tradition tells how Tiruvalluvar, as he is familiarly called, composed his Kural at the request of his neighbours, in order that the Tamil people might have a Veda of their own. The work, when finished, was taken by its author to the great college of Tamil, situated at Madura, where was the sacred bench of solid diamond presented to it by the god Siva himself, on which no one could sit who was not a faultless scholar. [illegible] of the low b[illegible]d a stir among the high-caste pundits, who declined to give him a seat on the bench on account of his want of caste. Tiruvalluvar, the story goes, meekly acquiesced in his exclusion, but simply requested to be permitted to lay his book at the end of the seat. On this being granted the book was placed where the poet should have been seated, and the whole bench at once disappeared, leaving the learned professors afloat in the Lotus tank. It seems a pity so good a story is not true, but it is inconsistent with the tradition that the president was Kapilar, himself a Pariah and a brother of Tiruvalluvar.

The date of the poem is probably between 800 and 1000 A.D. It has been the subject of twelve native commentaries, while every Hindu sect claims the great poet and strives to interpret his verses so as to favour its own dogmas. The Kural, no doubt, owes much of its popularity to its form, the exquisiteness of which is incapable of reproduction in a translation. The three books into which it is divided treat of Virtue, Wealth, and Pleasure. ("The Sacred Kural of Tiruvalluva-Nayanar. With Introduction, Grammar, Translation, Notes, &c.," by Rev. G. U. Pope. London, 1886.)

TI'RYNS, an ancient city of Argolis, in the Peloponnêsos, at no great distance from the head of the Argolic Bay. According to an old legend it was built by Proitos, an ancient king of Argolis, who in the construction of the citadel employed the Cyclopes. (The Greeks attributed most architectural works which were characterized by rude massiveness and great antiquity to the Cyclopes.) These constructions were the first rude attempts at building with stone among the Pelasgic Greeks; it used to be said that no mortar was used in them, and that the stones remained fixed by their own weight. This is now known to be erroneous. Probably the work is really Phœnician.

The ruins occupy the lowest and flattest of several rocky hills, which rise like islands out of the level plain. The length of the summit of Tiryns is about 308 yards, the breadth averaging 109 yards; the height above the plain, from 20 to 50 feet; the direction, nearly north and south. The entire circuit of the walls still remains more or less preserved. The walls are about 24 feet thick, and are built of roughly hewn stones. Formerly Cyclopean masonry was deemed "natural," but Schliemann and Dörpfeld have shown the actual marks of the tools in all cases. The most remarkable excavation at Tiryns, conducted by Dr. Schliemann and described in his fine volume of 1885, showed for the first time from actual remains the construction of an ancient Greek palace, with its stone ground-floor and wooden first-storey, &c.; together with many other valuable facts in archæology.

TISCH'ENDORF, LOBEGOTT FRIEDRICH KONSTANTIN VON, a great New Testament critic, was born 18th January, 1815, at Langenfeld, in the Saxon Voigtland, Germany. After studying theology and philosophy at Leipzig from 1834, he became a *privat-docent* there in 1839, and for some years after travelled over a great part of Europe and the East in search of materials for a revision of the text of the New Testament. After his return he was appointed extraordinary professor of theology at Leipzig in 1845, and ordinary professor in 1859. In 1853 and 1859 he undertook a second and third journey to the East, particularly to Egypt and Sinai. His third journey resulted in the discovery at the Convent of St. Catharine, near Mount Sinai, of the famous "Codex Sinaiticus." The Sinaitic manuscript was printed in facsimile type (four vols. fol., St. Petersburg, 1862). Tischendorf received from the Russian government 100 copies, with permission to sell them at about £40 each. In 1863 was published an abridged edition of it, containing only the New Testament, "Barnabas," and a portion of the "Shepherd of Hermas," and giving the manuscript line for line, but in ordinary type. Tischendorf died 7th December, 1874. His works relate chiefly to textual criticism of the New Testament.

TISIPH'ONE, one of the Furies (Greek mythology). See EUMENIDES.

TISSUES, ORGANIC ANIMAL. See HISTOLOGY.

TIT. See TITMOUSE.

TITA'NIA, Queen of the Fairies, consort of OBERON. The name is given to Diana by the Roman poet Ovid, and is therefore eminently applicable to the queen of faëry, who is, as it were, the modern spirit of moonlight.

TITAN'IC IRON ORE, or **IL'MENITE,** is a black opaque mineral, of metallic lustre, consisting of the combined oxides of iron and titanium. It may be regarded as a form of hematite, in which a portion of the iron is replaced by titanium, and the latter rare metal was first discovered in this mineral. It is very widely distributed through rocks in minute grains and crystals, and is sometimes met with in workable quantities, as at Krageroe, in Norway, and at Bay St. Paul, in Canada. On decomposing it becomes surrounded by a white secondary product, often seen in microscopical sections of rocks, which appears to be either titanic acid or a silicate of the metal. By taking account of this circumstance, minute particles can often be distinguished from those of magnetite, which otherwise present no points of difference except on chemical analysis.

TITA'NIUM, a rare metal, first discovered by Gregor in 1789 in the titaniferous iron-sand or menachanite of Cornwall. It is not found in the metallic state, but it is present in minute quantities in many iron ores, some of which contain a considerable amount of titanium, as ferrous titanate. The best sources are rutile, brookite, and anastase, which consist of impure oxide of titanium. It is also found associated with cerium, yttrium, and tantalum, in euxenite, polycrase, and pyrochlore; and in perowskite as titanate of calcium, and in titanite as silico-titanate of calcium. It is often found in cubic copper-coloured crystals as a nitride of titanium in blast furnaces where titaniferous iron ores are smelted. It is obtained in the pure state by heating the double fluoride of titanium and potassium with potassium, and washing out the potassium fluoride with water. It is thus obtained as a dark green powder. It may also be prepared by reducing the oxide with charcoal, but this requires a very high temperature. The pure metal burns in air with great brilliancy, and in oxygen with still greater splendour. It does not decompose water in the cold, but when heated hydrogen is evolved. The same occurs with hydrochloric acid when heated with it. The symbol is Ti, the atomic weight 50. It forms an alloy with iron, and is often present in minute quantity in pig-iron, from one-half per cent. to one per cent.; it is said to improve the quality of iron and steel, and the use of it for this purpose has been patented. It also forms a brown alloy with aluminium, having the composition Al_3Ti. There are two oxides of titanium, the sesquioxide or titanous oxide (Ti_2O_3), and the dioxide or titanic oxide, or titanic anhydride (TiO_2).

Titanous oxide is a black powder obtained by reducing the titanic oxide with hydrogen; at a higher temperature

it is reoxidized to titanic oxide. It dissolves in acids, forming solutions having a violet colour; the sulphate is the only salt that is known in the solid state; the solution is a powerful reducing agent; the salt ($Ti_2O_33SO_3$) crystallizes in a violet deliquescent mass.

Titanic oxide occurs native as rutile, brookite, and anastase. It is a reddish brown powder, which may be obtained in needle-shaped crystals at a high temperature. It forms two hydrates or titanic acids, analogous to stannic and metastannic acids, and called tetanic and metatetanic acids. Tetanic acid (H_2OTiO_2) is precipitated by ammonia from solution of tetanic chloride as a white heavy powder, which becomes yellow on heating, and white again on cooling. At a higher temperature it becomes highly incandescent, and is converted into tetanic oxide. It is soluble in dilute sulphuric, hydrochloric, and nitric acids, and when the solutions are boiled metatetanic acid ($H_2TiO_3TiO_2$) is deposited as a white powder, insoluble in acids. Titanic acid acts as a weak base, forming unstable salts, and it acts also as an acid, forming salts with bases called tetanates. The sulphate of titanium is a white powder, having the formula TiO_2SO_3. The titanates are mostly insoluble, even those of the alkalies; the usual formula is M_2TiO_3. The titanate of calcium ($CaTiO_3$) occurs native in perowskite. The titanate of iron, or ferrous titanate (Fe_2TiO_4), occurs native as ilmenite.

There are two chlorides of titanium, the trichloride or titanous chloride ($TiCl_3$), and the tetrachloride or titanic chloride ($TiCl_4$). Titanous chloride forms dark violet deliquescent scales, which, when heated in the air, are converted into titanic chloride and titanic oxide. It forms a violet unstable solution with water, which acts as a powerful reducing agent, reducing gold and silver from their solutions. Titanic chloride is formed when titanium is ignited in chlorine gas, in which it burns with great brilliancy. It is a colourless heavy liquid, of specific gravity 1·7609, and boiling at 135° C. (275° Fahr.) It combines with water, the mixture giving great rise of temperature; the solution when heated gives off hydrochloric acid, and titanic acid is deposited. One bromide of titanium only is known, the tetrabromide ($TiBr$); it is an amber coloured crystalline mass, melting at 39° C. (102° Fahr.), and boiling at 230° C. (446° Fahr.), and soluble in water.

The iodide of titanium, or tetanic iodide (TiI_4), crystallizes in red silky prisms, which melt at 150° C. (302° Fahr.), and boil at 360° C. (680° Fahr.) It is soluble in water.

Two fluorides of titanium are known, titanous fluoride (TiF_3), a violet powder, and titanic fluoride (TiF_4), a fuming colourless liquid.

Titanium is detected in minerals by the violet colour imparted to borax, or to microcosmic salt in the inner blowpipe flame; titanic salts are recognized by their insolubility in water and solubility in acids, from which solutions the titanic acid is precipitated on boiling. In the hydrochloric acid solution, metallic tin evolves hydrogen, and forms a dark violet precipitate, and the violet blue solution, a reaction which is very delicate. The metal is always estimated as titanic oxide, which is precipitated from the acid solution by ammonia.

TI'TANS, the second race of gods in the Greek mythology, were children of the primeval deities Ouranos and Gaia, *i.e.* of sky and earth. They were twelve in number, and were dethroned by the children of one of them, Kronos (Lat. *Saturn*). See the full list and detailed account of them contained in the article MYTHOLOGY.

TITHES are the tenth part of the increase yearly arising from the profits of lands, the stock upon lands, and the personal industry of the inhabitants, and are offerings payable to the church by law. Under the Jewish system, the tenth part of the yearly increase of their goods was due to the Levites as a substitute for the landed inheritance which they forfeited by their consecration to the temple worship, and also as a compensation for their services. Other tithes were also prescribed for the sacrifices of the temple, and at particular periods for the poor (Num. xviii. 21; Deut. xiv. 22; Lev. xxvii. 30, 32).

In the earliest ages of the Christian church, offerings were made by its members at the altar, at collections, and in other ways; and such payments were enjoined by decrees of the church, and sanctioned by general usage. For many centuries, however, they were voluntary, and it does not appear that the payment of tithes was ever enjoined as obligatory by the Greek or other Eastern churches. The first known canonical enactment made for that purpose in the Latin Church was a statute of the Second Council of Tours in 567, and this collection was enforced under pain of excommunication by the second council of Mâcon in 585. The Frank emperor Charles the Great established them by decree in the eighth century. In England the first law in relation to them is believed to have been that of Offa, king of Mercia towards the end of the eighth century (794). He first gave the church a civil right in tithes, and enabled the clergy to recover them as their legal due. The law of Offa was at a later period extended to the whole of England by King Ethelwald (846). (Prideaux, "On Tithes," 167.)

At first, though every man was obliged to pay tithes, the particular church or monastery to which they should be paid appears to have been left to his own option. In the year 1200, however, Pope Innocent III. directed a decretal epistle to the Archbishop of Canterbury, in which he enjoined the payment of tithes to the parsons of the respective parishes. This parochial appropriation has ever since been the law of England (Coke, 2 "Inst." 641).

The tithes thus payable were of three kinds—*prædial*, *mixed*, and *personal*. *Prædial tithes* are such as arise immediately from the ground, as grain of all sorts, fruits, and herbs. *Mixed tithes* arise from things nourished by the earth, as colts, calves, pigs, lambs, chickens, milk, cheese, and eggs. *Personal tithes* are paid from the profits arising from the labour and industry of men engaged in trades or other occupations; but it is commonly held that personal tithes were ordinarily paid in the form of a voluntary offering at Easter or some other period of the year. No tithes are paid for quarries or mines, because their products are not the increase, but are part of the substance of the earth. Neither are houses (considered separately from the soil) chargeable, as having no annual increase. The common law, moreover, held wild animals, game, fish, &c., not to be proper subjects of tithe, nor tame animals kept for pleasure or curiosity, and not for profit or use.

Tithes are further divided into *great* and *small*. The *great tithes* consist of corn, hay, wood, &c.; the *small tithes* consist of the prædial tithes of other kinds, together with mixed and personal tithes. The distinction is of material consequence, as great tithes belong to the rector of the parish, and small tithes to the vicar.

Tithes were originally paid in kind: that is, the tenth wheat sheaf, the tenth lamb or pig, as the case might be, belonged to the parson of the parish as his tithe. The inconvenience and vexation of such a mode of payment are obvious; and sometimes the owner of land would enter into a composition with the parson or vicar, with the consent of the ordinary and the patron of the living, by which certain land should be discharged from tithes, on other land being conveyed for the use of the church or compensation being made. Such compositions, however, were often injurious to the church by reason of an insufficient value being given for the tithes. The Acts 1 Eliz. c. 19, and 13 Eliz. c. 10, were accordingly passed, which disabled archbishops, bishops, colleges, deans, chapters, hospitals, parsons, and vicars, from making any alienation of their property for a longer term than twenty-one years or three

lives. In order to establish an exemption from tithes on the ground of a real composition, it is therefore necessary to show that such composition was made before the statutes of Elizabeth. Since that time compositions have rarely been made, except under private Acts of Parliament.

Another method of avoiding the payment of tithes in kind was by a *modus decimandi*, commonly called a *modus*; that is, any custom or special manner of tithing common in a particular place.

A large portion of the land of England and Wales is tithe-free. Some has been exempted under real composition, and some by prescription, which supposes a composition to have been made. The most frequent ground of exemption is that the land once belonged to a religious house, and was then tithe-free. The Act 31 Hen. VIII. c. 13, which dissolved several of the religious houses, continued the discharge of their lands from tithes, though in possession of the king or any other person by grant from the crown; and in consequence of this, the lands of many laymen which were granted by the crown are tithe-free, and the right to tithe and the property in many rectories are vested in laymen. Many monasteries had previously been dissolved by Act of Parliament, but as no such clause as that contained in the 31 Hen. VIII. had been introduced into other Acts, the lands of the monasteries dissolved by them became chargeable with tithes.

Tithes are payable not only to spiritual persons, but to lay impropriators; they have been the subject of innumerable bargains; land has been sold at a higher price on account of its exemption from tithe; the value of the patronage of the greater portion of the livings of this country is dependent upon the existing liability of land to tithes; in short, the various relations of society have been for centuries so closely connected with the receipt and payment of tithes, that to have abolished them would have been injustice to many, and no advantage to the community; for the whole profit would immediately have been enjoyed by those whose lands were discharged from payments to which they had always been liable, and subject to which they had most probably been purchased. In 1886 a lay impropriator recovered tithes on a property which had paid none for 340 years, the decision being regretted by none more than by the judge who was forced to give it.

The principle of the commutation of tithes was first proposed to be applied to Ireland. In addition to the common evils of a tithe system, that country was labouring under another. The mass of the people, who are Roman Catholics, were paying tithes to a Protestant clergy. Resistance to the payment of tithes had become so general that a commutation was deemed necessary for the safety of the Church of Ireland. It was recommended by committees of both Houses of Parliament in 1832, but not finally carried into effect until 1838. The Disestablishment Act of 1869 abolished tithes in Ireland, and created a common fund for the support of the Protestant Episcopal Church and clergy.

By the Tithe Commutation Act of 1836 (6 & 7 Will. IV. c. 71), and by various Acts since passed for its amendment, a plan was provided to substitute a rent-charge, payable in money, but varying according to the average price of corn for seven preceding years, for all tithes, whether payable under a *modus* or composition, or not. A voluntary agreement between the owners of the land and of the tithes was first promoted, and in case of no such agreement a compulsory commutation was to be effected by commissioners. In case of dispute, provision was made for the valuation and apportionment of tithe in every parish. The rent-charge is thus calculated: the comptroller of corn returns is required to publish in January the average price of an imperial bushel of British wheat, barley, and oats, computed from the weekly averages of the corn returns during seven preceding years. Every rent-charge is of the value of such number of imperial bushels and decimal parts of an imperial bushel of wheat, barley, and oats, as the same would have purchased at the prices so ascertained and published, in case one-third of such rent-charge had been invested in the purchase of wheat, one-third in barley, and the remainder in oats. For example, suppose the value of the tithe of a parish to have been settled by agreement or by award at £300, and that the average price of wheat for the seven preceding years had been 10*s.* a bushel, of barley 5*s.*, and of oats 2*s.* 6*d.*; the £300 would then represent 200 bushels of wheat, 400 bushels of barley, and 800 bushels of oats. However much the average prices of corn may fluctuate in future years, a sum equal in value to the same number of bushels of each description of corn, according to such average prices, will be payable to the tithe-owner, and not an unvarying sum of £300.

The quantity of corn is fixed, but the money payment to the tithe-owner varies with the septennial average price of corn. From Willich's "Annual Tithe Commutation Tables" it appears that, if we include the whole period which elapsed from the passing of the Tithe Commutation Act to the year 1887, it will be found that the general annual value of £100 tithe rent-charge amounted to £102 5*s.* 8*d.* The amount for 1887 was £87 8*s.* 10*d.* In 1883 it was £107 2*s.* 10*d.* The Commutation of Tithes Amendment Act of 1878 (41 & 42 Vict. c. 42) enables landlords, with the consent of the bishop and patron, to purchase, and so extinguish the tithe rent-charge, at not less than twenty-five years' purchase.

We must not omit to mention an improvement in the mode of recovering tithes, consequent upon the commutation. There were formerly various modes of recovery, in the ecclesiastical as well as in the civil courts, and before justices of the peace. The present mode of recovering the rent-charge, if in arrears, is by distraining for it upon the tenant or occupier, in the same manner as a landlord recovers his rent; and if the rent-charge shall have been forty days in arrear, possession of the land may be given to the owner of the rent-charge until the arrears and costs are satisfied.

Tithes, or teinds, in Scotland are regulated by a series of statutes, chiefly in 1632, 1633, and 1690, &c. Questions of teinds and augmentation of ministers' stipends are decided by the judges of the Court of Session sitting as the *Teind Court*, under Act 1617, c. 3, and subsequent statutes.

During recent years, owing to agricultural depression and other causes, there has been a good deal of friction in many parts of England and Wales in connection with the payment of tithes, especially those known as "extraordinary tithes," or those payable on certain kinds of crops, *e.g.* hops and fruit, in addition to the ordinary tithe. In many cases farmers have either pleaded inability to pay anything or have only consented to pay on the concession of a stipulated reduction. To meet in some measure the difficulty which has arisen a Bill was introduced by the Government of Lord Salisbury in 1887, by which it was proposed to make tithe the debt of the landowner, and to give the tithe-owner the same remedies against the owner that he has for any other kind of debt. In return for this transfer the landowner was to be allowed to deduct 5 per cent. from the tithe due, and to have the privilege of redeeming the tithe at twenty years' purchase of the par value. A further provision was, that tithe should cease to be payable when it should be shown to the satisfaction of a county court judge that the land did not yield its value.

TI'THING (*tithinga*, from the Old English *teoda*, or *teon-tha* with the *n* dropped out), an ancient division of land in England. The whole country is said to have been divided into tithings and hundreds by Alfred the Great. The tithing was a district presided over by an officer annually elected, and containing ten heads of families;

the hundred comprised ten tithings, or 100 heads of families. Each of these little communities was bound to keep the peace within its own jurisdiction, and the members were responsible for each other. No man was allowed to abide in England above forty days without being enrolled in some tithing. Tithings are still retained as divisions in many parts of England.

TITHO'NOS was a beautiful youth beloved by Eôs (Lat. *Aurora*), the dawn-goddess. He was son of Laomedôn and brother of Priam, the two kings of Troy. He desired immortality, and his goddess-wife obtained the gift; but having neglected to ask also for eternal youth, he became miserably old and shrivelled, and at his own prayer was turned into a grasshopper. His dried-up body and piping voice may be seen and heard in his numerous descendants.

TI'TIAN or **TIZIA'NO VECELLIO,** the most distinguished painter of the Venetian school, was born at Capo del Cadore, in the Venetian state, in 1477. He studied painting at Venice, first with Sebastiano Zuccati, then with Gentile Bellini, and finally with Giovanni Bellini, in whose studio he had Giorgione as a fellow-pupil: they were both born in the same year. The earlier works of Titian are very highly finished, after the manner of the eminent Venetian painters of that time; it was only as he advanced in life that his manner became bold and free. In 1512 Titian was commissioned by the Venetians to continue the works in the council hall which the great age of Bellini prevented him from completing, for which he obtained in 1516 the office of painter of the portraits of the doges, worth 120 crowns a year. Titian painted five doges; two others at the end of his time he could not paint on account of his age. After this appointment he rose rapidly to distinction. In 1516 he was employed at the court of Alfonso I., duke of Ferrara, and it was there he painted the "Bacchus and Ariadne," in the National Gallery. In 1516 he painted the magnificent picture of the "Assumption of the Virgin," now in the academy of Venice; and in 1528 the "St. Peter Martyr," for the church of SS. Giovanni e Paolo, destroyed by fire not long since, to the regret of the entire art-world. Titian's great patrons, however, were Charles V. and his son Philip II. of Spain. He painted the emperor twice at Bologna, in 1530 and 1532. Charles created him a count palatine and a knight of the order of St. Jago in 1533, and granted him also a pension of 400 crowns a year, which was continued by Philip. Titian is wrongly said to have visited Spain at this time. The Real Museo of the Prato at Madrid possesses forty pictures by Titian, including some of his finest works, and a replica of the "Martyrdom of St. Lawrence," much injured, is the chief ornament of the Jesuits' Church, Venice. Titian visited Rome in 1545–46, and painted Paul V., who, after the death of Sebastian del Piombo in 1547, offered his post (keeper of the leaden seals) to the Venetian painter, but Titian declined the honour; it would have involved his living at Rome. Michelangelo visited Titian while he was at Rome, and expressed a high opinion of his powers as a painter, but Vasari says he noticed his want of thoroughness in drawing. Ariosto, who was painted by Titian at Ferrara in 1516, has paid him an appropriate compliment in his "Orlando Furioso," saying that he was as great an honour to Cadore as Sebastian del Piombo to Venice, or Raffaelle to Urbino:—

> "Bastiano, Rafael, Tizian, ch' onora
> Non men' Cadore, che quel Venezia e Urbino."

An admirable early portrait of Ariosto by Titian is now in the National Gallery. Other very famous pictures by Titian are the "Sacred and Secular Love," Borghese Palace, Rome, and the Duchess of Urbino and the Venus at Florence. Titian was married: he had three children by his wife Cecilia—Pomponio, born in 1525; Orazio, his favourite, born about 1527; and Lavinia, the daughter he has frequently painted, born in 1529 or 1530; his wife died in the summer of the latter year. Titian survived her forty-six years; he died at Venice of the plague, on the 27th of August, 1576, at the great age of ninety-nine, and in full possession of all his faculties. He is buried in the church of the Frari. His son Orazio, an excellent portrait painter, was a victim to the same pestilence. Pomponio Vecellio, who was brought up to the priesthood, and led a scandalous life, survived his father some years; he was living in 1594. In later life Titian is said to have had a mistress named Violante, and she has been called the daughter of his pupil Palma Vecchio; but Palma's daughter Violante can have been but a girl at the time of Titian's death. Titian, Aretino, and the architect Sansovino, were inseparable friends. To comprehend fully the great powers of Titian it is necessary to have seen his works at Venice or at Madrid, where alone he is seen to the utmost advantage. He is unquestionably the *capo-scuola* of the Venetian painters, and ranks, by common consent, with Raffaelle, Lionardo da Vinci, and Michelangelo. He is considered the prince of colourists. In portrait painting he is acknowledged to be the greatest master. The National Gallery is rich in examples by Titian, three of the examples having landscape backgrounds of the highest order—the "Noli me tangere," the "Triumph of Bacchus," and the "Virgin and Child, with St. Catherine." Titian's brother, Francesco Vecellio, was also an excellent painter, but he turned his attention to commerce in the latter part of his life. He died unmarried in 1560, aged seventy-five.

TIT'LARK. See PIPIT.

TITLE, ABSTRACT OF, is a document delivered by the vendor to the purchaser of property after the contract for sale is made, but before the deeds actually conveying property are prepared. It sets out as concisely as possible the different steps in the title to the particular property, and must always commence with the document of, at least, the requisite age, if the vendor have one; but he would not be justified in furnishing an abstract of deeds prior in date to that which would constitute a good root of title. The abstracted documents should purport to deal with the entire legal and equitable estates of the property. This abstract is unknown in Scotch conveyancing, where generally the series of titles being first entered on the public registers are delivered to the purchaser.

TITLES OF HONOUR are designations which certain persons are entitled to claim in consequence of possessing certain dignities or stations. They vary in a manner corresponding to the variety of the dignities. Thus Emperor, King, Tsar, Prince, are titles of honour.

The five orders of nobility in England are distinguished by the respective titles of Duke, Marquis, Earl, Viscount, and Baron. Those in other European countries differ little from our own.

Two other dignities which bring with them the right to titles of honour, are those of baronetcy and knighthood. The former originated in the reign of James I.

Besides these, there are the ecclesiastical dignities of Bishop and Archbishop. It is also usual to bestow on all persons who are admitted into the clerical order the title of Reverend, which title was formerly given to others quite as appropriately; to judges, for instance.

There are also academical distinctions which partake of the nature of titles of honour. Municipal offices have titles accompanying them; and in the law there are eminent offices whose names become titles of honour to their possessors, and bring with them the right to certain terms of distinction.

All titles of honour appear to have been originally names of office. The Earl in England had in former ages substantial duties to perform in the county, as the sheriff (the vice-comes or vice-earl) has now; but the name has survived while the peculiar duties are gone, and so it is with respect to other dignities.

Some of these dignities and the titles correspondent to them are hereditary, as were the eminent offices which they designate in the remote ages when there were duties to be performed. Hence hereditary titles.

The distinction which the possession of titles of honour gives in society has always made them objects of ambition. Such titles exist even in democratical states, as in the United States of North America; but there they are only temporary and annexed to certain offices, as that of President.

Titles of Courtesy are assumed by or given to individuals, and have no validity in law. Peers often possess several titles, and as they only use the highest, it is—by popular consent—permitted by their eldest sons to assume one of the inferior titles. Thus the Duke of Westminster being also Earl Grosvenor, his eldest son takes the latter title. The younger sons of dukes and marquises have the courtesy title of "Lord" prefixed to their Christian and surname, as Lord George Hamilton, second son of the Duke of Abercorn. The eldest son of an earl, when not a viscount, takes his father's second title of "Lord," as for example, the eldest son of Earl Shaftesbury is styled Lord Ashley. These titles do not raise their bearers above the rank of commoners, nor do they render them ineligible for election as members of the House of Commons. The daughters of dukes, marquises, and earls have the title Lady prefixed to their Christian and surname, though the only title they can legally claim is that of Honourable, in common with the sons and daughters of all peers. Baronets' and Knights' wives are by courtesy called "Lady," their proper designation being "Dame." The title "Right Honourable" is given by courtesy to the Lord Mayor, the Speaker of the House of Commons, to all privy councillors, and some few officials. The titles of "Mr." or "Master" and "Esquire" are now given to nearly all classes of persons. The order of precedence in social rank of the various classes of British subjects is given in the article PRECEDENCE.

As great care is requisite in the formal modes of addressing letters to persons of title and rank, we subjoin a table of the customary forms of address, adding also the proper commencement and conclusion of every such letter.

THE ROYAL FAMILY.

The Queen (or King). Address: To the Queen's (or King's) most excellent Majesty. Commence: Madam (or Sire), May it please your Majesty. Conclude: I remain, your Majesty's most faithful Subject and dutiful Servant.

Princes. Address: To his Royal Highness the Prince of Wales. Commence: Sir. Conclude: I am, with the greatest respect, Sir, your Royal Highness' most dutiful and most humble Servant. Address: To his Royal Highness the Duke of Cambridge, General Commander-in-Chief. Commence: Sir. Conclude: I am, your Royal Highness' most dutiful and most humble Servant.

Princesses. Address: To her Royal Highness the Princess —. Commence: Madam. Conclude: I remain, with the greatest respect, Madam, your Royal Highness' most devoted and most humble Servant.

Wives of Princes. (In like manner as to Princesses.)

THE NOBILITY AND GENTRY.

Dukes. Address: To the Most Noble his Grace the Duke of ——. Commence: My Lord Duke. Conclude: I have the honour to be, my Lord Duke, your Grace's most devoted (or, most obedient humble) Servant.

Duchesses. Address: To her Grace the Duchess of —— Commence: My Lady (or, Madam), May it please your Grace ——. Conclude: I have the honour to be, my Lady (or, Madam), your Grace's most devoted (or most obedient and humble) Servant.

Marquises. Address: To the Most Honourable* the Marquis of ——. Commence: My Lord. Conclude: I have the honour to be, my Lord, your Lordship's most obedient and humble Servant.

Marchionesses. Commence: My Lady (or Madam). Conclude I have the honour to be, my Lady (or Madam), &c., &c.

*A Marquis is often styled the Most Noble, but he is really only entitled to Most Honourable.

Earls. Address: To the Right Honourable the Earl of —. Commence: My Lord. Conclude: I have the honour to be, my Lord, &c., &c.

Viscounts. Address: To the Right Honourable the Lord Viscount——. Commence: My Lord. Conclude: I have the honour, to be, my Lord, your Lordship's most obedient Servant.

Barons. Address: To the Right Honourable Lord ——. Commence: My Lord. Conclude: I have the honour to be, my Lord, your Lordship's most obedient Servant.

Countesses, Viscountesses, and Baronesses. (In like maner as to Earls, Viscounts, and Barons.)

Baronets. Address: To Sir B—— H——, Bart. Commence: Sir. Conclude: I have the honour to be, Sir, your very humble Servant.

Knights. Address: To Sir J—— P——, Knt. Commence: Sir. Conclude: I have the honour to be, Sir, &c., &c.

The Speaker of the House of Commons. Address: To the Right Honourable —— —— Speaker of the House of Commons. Commence: Sir (or Mr. Speaker). Conclude: I have the honour to be, Sir, your most obedient Servant.

Members of the House of Commons not Ennobled. Address: To —— ——, Esq., M.P. Commence: Sir. Conclude: I have the honour to be, Sir, your most obedient Servant.

Wives of Baronets and Knights. Address: To Lady ——. Commence: Madam. Conclude: I have the honour to be Madam, your Ladyship's obedient, humble Servant.

Esquire. (From the French, *écuyer*, a shield bearer). Originally a title of honour appropriated to the sons of knights, which has gradually lost its honourableness, and is now commonly given to every man not engaged in retail trade.

Sons of Peers. The eldest sons of dukes, marquises, and earls take, by courtesy, the father's second title. The younger sons of dukes and marquises are also styled Lords, and are addressed as such, with the addition of their Christian names. Address: To the Lord George ——. Commence: My Lord. Conclude: I have the honour to be, my Lord, your Lordship's most obedient Servant. The younger sons of earls, and all the sons of viscounts and barons are styled Honourable. Address: To the Honourable George ——. Commence: Sir. Conclude: I have the honour to be, Sir, Your most obedient Servant.

Wives of the sons of Peers are addressed in conformity with the titles of courtesy possessed by their husbands.

Daughters of Peers. The daughters of dukes, marquises, and earls are styled Ladies; and addressed as such, with the addition of their Christian names. Should they marry a person of inferior rank, they retain their title and precedence, changing only the surname. Address: To the Right Honourable Lady — —. Commence: My Lady. Conclude: I have the honour to be, my Lady, your Ladyship's most obedient Servant. The daughters of viscounts and barons are styled Honourable. Address: To the Honourable Miss ——. Commence: Madam. Conclude: I have the honour to be, Madam, your most obedient Servant.

Widows of Peers. The widows of noblemen are addressed by their proper titles, with the word Dowager prefixed. Address: To the Right Honourable the Dowager Countess of ——.

Privy Councillors are all Right Honourables, and have that title prefixed to their names.

THE NAVY.

Admirals, when addressed formally, have the rank of their flag added to their name and title, as—To Sir —— ——, Bart., Admiral of the Blue.

Vice-admirals and Rear-admirals. (As to Admirals.)

Commodore is a local rank, and seldom employed except in official addresses.

Captains. To Captain George —— ——, R.N. (Royal Navy). To persons of rank place the Captain before their title, as—To Captain the Right Hon. Lord ——.

THE ARMY.

The military rank of all officers, above subalterns, is prefixed to their name and title, as—To General the Right Honourable Lord ——, G.C.B.

Lieutenants are addressed as Mr., or, by courtesy, Esq., with the name of the regiment, if on service.

THE CLERGY.

Archbishops. Address: To the Most Reverend his Grace the Lord Archbishop of ——. Commence: My Lord Archbishop. Conclude: I remain, with the highest respect, my Lord Archbishop, your Grace's most devoted Servant.

Bishops. Address: To the Right Reverend the Lord Bishop of ——. Commence: My Lord Bishop. Conclude: I have the honour to be, my Lord Bishop, your Lordship's most humble Servant.

Scottish Bishops. Address: To the Right Reverend the Bishop of ——. Commence: Right Reverend Sir. Conclude: I have the honour to be, Right Reverend Sir, your most obedient Servant.

Deans. Address: To the Very Reverend the Dean of —— ——. Commence: Mr. Dean, or Reverend Sir. Conclude:

I have the honour to be, Reverend Sir, your most obedient Servant.

Archdeacons. Address: To the Venerable the Archdeacon ——. Commence: Mr. Archdeacon, or Reverend Sir. Conclude: I have the honour to be, Venerable Sir, your most obedient Servant.

Doctors of Divinity. Address: To the Reverend —— ——, D.D., or to the Reverend Dr. ——. Commence: Reverend Sir. Conclude: I have the honour to be, Reverend Sir, your most obedient Servant.

When baronets are clergymen, their clerical title is first mentioned, but if they are Right Honourables, or Honourables, these titles precede the clerical title.

Clergymen. Address: To the Reverend —— ——, M.A. Commence: Reverend Sir. Conclude: I have the honour to be, Reverend Sir, your most obedient Servant.

JUDGES, LAWYERS, &c.

All the judges, if privy councillors, are styled Right Honourable.

Lord Chancellor. Address: To the Right Honourable the Lord High Chancellor of Great Britain. Commence: My Lord. Conclude: I have the honour to be, my Lord, your most obedient Servant.

Lord Chief Justice. Address: To the Right Honourable the Lord Chief Justice of the Court of Queen's Bench (or of Common Pleas). Commence: My Lord. Conclude: I have the honour to be, my Lord, your most obedient Servant.

Master of the Rolls. Address: To the Right Honourable the Master of the Rolls. Commence: Sir. Conclude: I have the honour to be, Sir, your most obedient Servant.

The Lord Advocate. Address: To the Right Honourable the Lord Advocate. Commence: My Lord. Conclude: I have the honour to be, my Lord, your most obedient Servant.

Vice-chancellors. Address: To his honour the Vice-chancellor ——. Commence: Sir. Conclude: I have the honour to be, Sir, your most obedient Servant.

Puisne Judges. Address: To the Honourable Mr. Justice ——. Commence: Sir. Conclude: I have the honour to be, Sir, your most obedient Servant.

Lord Chief Baron. Address: To the Right Honourable the Lord Chief Baron of the Court of Exchequer. Commence: My Lord. Conclude: I have the honour to be, my Lord, your most obedient Servant.

Barons. Address: To the Honourable Mr. Baron ——. Commence: Sir. Conclude: I have the honour to be, Sir, your most obedient Servant.

Sergeants. Address: To Mr. Sergeant ——. Commence: Sir. Conclude: I have the honour to be, Sir, your most obedient Servant.

THE MAGISTRACY.

The Lord Mayor of London. Address: To the Right Honourable the Lord Mayor of London. Commence: My Lord. Conclude: I have the honour to be your Lordship's most obedient Servant.

Mayors. Address: To his Worship (or, to the Worshipful) —— ——, Esq., Mayor of ——. Commence: Sir. Conclude: I have the honour to be, your Worship's most obedient Servant.

Aldermen. Address: To Mr. Alderman W——. Commence: Sir. Conclude: I have the honour to be, Sir, your most obedient Servant.

Governors of Colonies, &c. Address: To his Excellency Sir —— ——, Governor of ——. Commence: Sir. Conclude: I have the honour to be, Sir, your most obedient Servant.

PETITIONS.

Applications to the Queen in Council, Houses of Lords and Commons, &c., are by petitions, which are drawn out as follows, altering the title only as occasion requires:—

Address: To the Queen's Most Excellent Majesty in council The humble petition of —— —— of the City of —— ——. (Profession). Commence: Humbly showeth, That your Petitioner, &c., &c. Wherefore your Petitioner humbly prays that your Majesty will be graciously pleased to. Conclude: And your Petitioner, as in duty bound, will ever pray.

House of Lords. Address: To the Right Honourable the Lords Spiritual and Temporal of the United Kingdom of Great Britain and Ireland, in Parliament assembled. Commence: Humbly showeth, &c., &c. Conclude: And your Petitioner, as in duty bound, will ever pray.

House of Commons. Address: To the Honourable the Commons of the United Kingdom of Great Britain and Ireland, in Parliament assembled. Commence: Humbly showeth, &c., &c. Conclude: And your Petitioner, as in duty bound, will ever pray.

To Ambassadors. Direct: To his Excellency —— ——, her Britannic Majesty's Ambassador to the Court of ——. Begin: My Lord (or Sir, supposing the ambassador not to be ennobled); in continuation, Your Excellency. Conclude: I have the honour to be, My Lord (Sir), your Excellency's most obedient Servant.

To the Officers of her Majesty's Household. Address: To the Most Honourable the Marquis of B—— , Lord High Chamberlain (or Lord High Steward), &c., &c., &c. Commence: My Lord Chamberlain (or My Lord Steward). Conclude: I have the honour to be, my Lord, &c. (or according to rank of person addressed).

TIT'MOUSE or **TIT** (Paridæ) is a family of birds belonging to the order PASSERES. In this family the bill is short, strong, rather conical and straight, with the tip unnotched; the nostrils are generally concealed by bristles. The wings are moderate and pointed, with ten primaries. The tail is moderate or long, rounded or even. The tarsi are long, slender, and scaled in front; the inner toe is the shortest; the claws are strong and curved. The species are numerous, and are found all over the world, except in South America and the Australian region; in Africa they are sparingly represented. The titmice are small, bold, active birds, many of them adorned with beautiful colours. They feed on insects, seeds, and grain, sometimes on carrion, and some species kill small birds. The nests are generally made in the holes of trees or in the fork of the branches, and are composed of moss and grasses, and lined with hair, wool, and feathers. The eggs vary in number from six to twelve, and two broods are often produced in the year in temperate countries.

The Great Titmouse or Ox-eye (*Parus major*) is the largest British species; it is widely distributed over the whole of Europe and Northern Asia. It measures nearly 6 inches in length. The head, throat, a transverse band on the sides, and a longitudinal band on the breast and abdomen, are black; the rest of the under surface is yellow; the cheeks are white; the back is yellowish green, and the wings and tail grayish. The young birds have a tinge of yellow on the cheeks. It is not sociable, being generally seen in pairs. Its usual note is a kind of harsh chatter, but it often imitates the notes of other birds; in spring and early summer the notes resemble the filing of a saw, and may be heard to a great distance. This species is said occasionally to kill small birds by repeated blows on the head with its bill, after which it breaks open the skull and picks out and eats the brains.

The Blue Tit or Tomtit (*Parus cæruleus*), the handsomest and most familiar of our British titmice, is nearly 5 inches long, with the upper part of the head light blue, encircled with white; a band round the neck is duller blue; the cheeks are white, the back yellowish-green, the under parts pale grayish-yellow, and the middle of the breast dull blue. It is commonly seen in woods and plantations in the summer, but in the winter it frequently resorts to gardens and orchards, where it hops about the branches incessantly in search of insects. The eggs are usually from eight to ten, white, spotted with pale red. The female is very bold when sitting, puffing out her feathers when her nest is approached, hissing and pecking at the intruder's fingers, whence, in some parts of England, the expressive name "Billy biter" has been bestowed upon this bird. The Coal Tit (*Parus ater*) and Marsh Tit (*Parus palustris*) are common British species, especially in the southern counties. The Crested Titmouse (*Parus cristatus*), distinguished by the possession of a graceful crest of black and white feathers, is common in pine forests on the Continent, and is a rare visitor to Britain.

The Long tailed Titmouse (*Acredula caudata*), abundant in Britain, is distinguished by its long graduated tail, which consists of ten feathers only. The head, throat, and breast are white, the back, wings, and tail black, the latter margined with white; the under surface is brownish. The British species is distinguished from that of the Continent as a distinct species, *Acredula vagans*, by some on account of the broad black streak on each side of the head.

The long-tailed titmouse feeds upon insects, their larvæ and eggs, and displays great activity; it frequents copses, hedgerows, orchards, and large gardens, and builds a beautiful domed nest, in shape nearly oval, with one small hole in the upper part of the side by which the bird enters. The outside of this nest sparkles with silver-coloured lichens adhering to a firm texture of moss and wool, and the inside is profusely lined with soft feathers. The nest is generally placed in the middle of a thick bush, and con-

Long-tailed Titmouse (*Acredula caudata*). Male and Female.

tains from ten to twelve eggs, small and white, often marked with a few pale red specks. The young family of the year keep company with the parent birds during their first autumn and winter, and generally crowd close together on the same branch at roosting-time, looking, when thus huddled up, like a shapeless lump of feathers only. These birds have several notes, on the sound of which they assemble and keep together; one of these call-notes is soft and scarcely audible, a second is a louder chirp or twitter, and a third is of a hoarser kind.

The Bearded Titmouse (*Calamophilus biarmicus*), though abundant in Northern Europe, is comparatively rare in Britain. Unlike the other titmice, it frequents the reeds and sedges which line rivers, lakes, and ponds. Its food consists o' seeds, insects and their larvæ, and small-shelled snails.

The Penduline Titmouse (*Ægithalus* or *Paroides pendulinus*) is a native of Southern and Eastern Europe. Like the bearded tit, the penduline titmouse haunts the reedy banks of rivers, or the margins of "wide-watered" shores, and its food consists not only of the seeds of the reeds, but of aquatic insects and molluscs. It derives its name from its pensile purse-like or flask-like nest, generally suspended at the end of some willow twig or other flexible branch of an aquatic tree. This skilfully-wrought cradle is woven from the cotton like wool or down of the willow or poplar, with an opening in the side for the ingress and egress of the artificers and their young, and mostly overhangs the water; sometimes, however, it is interwoven among the reed-stems. The eggs, which are pure white, marked with some red spots or blotches, are generally six in number.

Several species of titmice occur in America, the best known being the Black-cap Titmouse or Chickadee (*Parus atricapillus*) and the Tufted Titmouse (*Lophophanes bicolor*), the latter being a little larger than our great titmouse.

TI'TUS, EPISTLE TO, a canonical book of the New Testament, addressed by the apostle Paul to his disciple Titus. This and the two epistles to Timothy form the pastoral letters of the apostle, all of which have so many points in common that commentaries on the Epistles to Timothy generally include also the Epistle to Titus, and the authenticity of the three is generally attacked and defended simultaneously. The date of the epistle has been the subject of much dispute, some scholars fixing it as early as the year 52, others as late as 65, and others at various intermediate years. The epistle furnishes Titus, who has been stationed at Crete, with rules of conduct for himself, especially in relation to the appointment of elders, the maintenance of Christian discipline in the church, the treatment of false teachers, and it enforces very strongly the necessity of good works upon all who have accepted the Christian faith. In its internal features it has most of the characteristics of the other pastoral epistles, together with certain marks in its phraseology and style which assimilate it to the general body of the epistles of St. Paul. It is also marked by a tone of sharpness and severity which seems to have been excited by the unworthy behaviour of the Cretan believers, and possibly also by the malignant opposition of the Judaizing opponents of the apostle. The controversy which has been raised in modern times concerning the authenticity of this epistle is noticed under TIMOTHY, EPISTLES TO.

TI'TUS FLA'VIUS SABI'NUS VESPASIA'NUS, Roman Emperor, the son of the Emperor Vespasianus, was born on the 29th of December, A.D. 40. He received his education together with young Britannicus, who was poisoned by the Emperor Nero in A.D. 55. Titus distinguished him.elf at an early age. The first campaign which he made was in Britain. The Jews, having been oppressed by Gessius Florus, revolted in A.D. 66. Vespasian, the father of Titus, set out to reduce them to obedience with three legions. One of these was commanded by Titus, who showed great military skill and courage, especially in the siege and capture of the towns of Tarichereæ and Gamala (A.D. 67). In the meantime the Emperor Nero was murdered, and Galba succeeded (A.D. 69). Vespasian sent his son Titus to Rome to congratulate the new emperor. By the time he reached Corinth he heard of the murder of Galba (January, A.D. 69), and of the imperial power being disputed between Otho and Vitellius. Upon this he prudently returned to his father in Judea. Vespasian was at once proclaimed emperor by the army in the East, and left Judea for Rome. The command of the army and the continuation of the war against the Jews were given to Titus, who prosecuted hostilities with such vigour that after a long siege Jerusalem was taken with great slaughter on 2nd September, A.D. 70. In this year Titus was created Cæsar by his father, and became his colleague in his first consulship. Being summoned home by Vespasian, he celebrated with him a triumph for their joint Jewish victories, which were also commemorated by the erection of a triumphal arch near the Forum, one of the finest existing monuments of ancient Rome. Titus loved Berenikê, the sister of Agrippa, the king of the Jews, and would have married her; but in deference to the hatred the Romans always felt for foreign marriages he sent her away, though she had come with him to Rome.

When Titus became emperor on the death of Vespasian, in A.D. 79, his virtuous conduct became the theme of general admiration. He took the office of supreme pontiff expressly that he might be unable to shed blood even if he would; and he used to say that a day without a good deed was a day lost. But during his short reign the empire was visited by great calamities. An eruption of Vesuvius destroyed the towns of Herculaneum, Stabiæ, and

Pompeii, and carried ruin over the fertile coast of Campania (August, A.D. 79). In A.D. 80 a conflagration swept over Rome, destroying a great part of the city. A plague next broke out, of which 10,000 persons died every day. Titus supported his unhappy subjects with the greatest liberality, and exhausted his treasures in giving them relief. He acted with great generosity towards his brother Domitian, who was charged with conspiring against his life. He amused the Romans with the splendid spectacles which he exhibited in the Colosseum (Flavian amphitheatre), which, commenced under Vespasian, was finished by Titus. The "Baths of Titus" was another magnificent work due to this emperor. During his reign the Roman commander Agricola tranquillized Britain and penetrated into Scotland. In A.D. 81 Titus, being ill in health, retired to a family villa at Reate, among the Sabine mountains, where his father had died. On 13th September he himself expired at this fatal spot, leaving behind him a memory which the people cherished. His brother Domitian was his unworthy successor. Rumours were even rife that he had hastened the death of Titus. A fine sestertius of Titus, with the profile of the emperor, is figured in Plate III., COINS.

TIUMEN' or **TOUMEN**, a town of Siberia in the government and 120 miles south-west of Tobolsk, is situated on both sides of the Toora, which is crossed by a wooden bridge. It has upwards of 100 factories of Russian leather, woollen fabrics, and soap; and around it coarse carpeting, carriages, mats, and wooden articles are made. Standing at the junction of several great routes, this place has an active export trade in tallow and bristles into Russia, and of Russian and other goods to the Kirghis territory and Bokhara. It is also a depot for the commerce between Russia and China. The inhabitants exceed 14,000.

TIV'ERTON, a municipal borough of England, in the county of Devon, situated on a hill at the confluence of the Lowman with the Exe, 15 miles north by west from Exeter, and 179 from London by railway. The town is clean (water being kept continually running down the sides of the streets), well paved, and in good condition. On the west side is a large suburb called Westexe, chiefly inhabited by the labouring classes. The chief manufacture of the town is of bobbinet, which gives employment to more than 1000 people. St. Peter's Church is a handsome Gothic structure, by some considered the finest church in the county, the greater part of which was rebuilt in 1853–56. There is also a chapel of ease, a Roman Catholic church, and places of worship for several classes of dissenters, many endowed charities, and numerous schools. The glory of Tiverton is its noble grammar-school, now housed in new buildings, founded by Peter Blundell in 1604, and which is handsomely endowed, and has several exhibitions tenable at Oxford or Cambridge. The usefulness of the school was much increased in 1876, and the instruction now given includes the curriculum of a first grade school. The town has an infirmary and athenæum. A handsome town-hall was opened in 1864. There are here the remains of the old castle built by Richard de Rivers in 1106. It was fortified, and withstood many sieges during the contests between the barons in feudal times, and suffered great injury in the Civil War between Charles and the Parliament. The principal gateway is an excellent sample of the architectural style of the age in which it was built. The municipal borough is governed by six aldermen and eighteen councillors. The population of the borough and parish, the limits of which are now identical, is 10,462. The separate parliamentary representation of the borough ceased in 1885. The name is derived from its situation at the junction of two rivers, the Exe and Loman—Twyfordton (Twofordtown).

TI'VOLI, the ancient *Tibur*, a town of Central Italy, 16 miles E.N.E. from Rome, situated on the slope of a hill on the left bank of the Anio or Teverone, just above the spot where that river, by a succession of beautiful falls, runs into the lowlands of the Campagna. Tibur existed as a town before the building of Rome, and was in the early history of the great city one of the principal members of the Latin Confederation. The mausoleum of the Plautii, in shape a massive round tower, is still seen at Ponte Lucano, a few miles from the town on the road to Rome. Augustus used to visit Mæcenas at his villa at Tibur, and Horace had a country house in the neighbourhood. Near here the Emperor Hadrian constructed a magnificent villa, of which extensive remains may still be seen, and which has contributed numerous antiquities to the Vatican. Under Aurelian, the famous Zenobia, queen of Palmyra, after having followed the triumphal procession of her conqueror, was, by order of the senate, banished to Tibur, where she is said to have lived many years.

Tivoli is one of the few ancient towns of Latium which occupies its original site. The temple of Vesta, commonly called "Della Sibilla," with its Corinthian pillars, still occupies its commanding position on a rock overhanging the river, and is in a good state of preservation; the temple of Hercules, in which Augustus held his tribunal, has been formed into a cathedral; the Roman road, or Via Tiburtina, crosses the town, and the Roman bridge called Ponte Celio, or Ponticelli, is still extant. There are considerable remains of the villa of Mæcenas near the Cascatelle, or smaller falls. Ruins of that of Quintilius Varus are shown near a church called Quintiliolo. Another round temple, vulgarly styled "Della Tosse," or of the goddess Tussis, is outside of the Roman gate. The castle built by Pope Pius II. still remains.

Modern Tivoli is a bishop's see; it has a college, a town library, and several manufactories of iron, leather, and paper. The population is about 7000. Near Tivoli are the extensive villa and ornamental park constructed about the middle of the sixteenth century by the Cardinal Ippolito d'Este. The vines of Tivoli are famed for a peculiar sort of grape, called "pizzutello" and "pergolese," which is in great request for the table. The building-stone called "travertine" is quarried near this.

TOAD (Bufonidæ) is a family of amphibians, belonging to the order BATRACHIA. The toads are distinguished from the FROGS (Ranidæ) by their thicker, more clumsy form, shorter hind legs, and the absence of teeth in the jaws. The fore feet have four toes, and the hind feet five, the web between the latter being only slightly developed. The skin is more or less covered with glandular warts, which secrete an acrid fluid; a similar secretion is contained in the large parotid glands. The Common Toad (*Bufo vulgaris*) is abundant in most parts of Britain, but is not found in Ireland. It has a wide range, extending from Western Europe through the temperate parts of Asia to China and Japan. It is from 3 to 3½ inches long, of a lurid brownish-gray colour; the tubercles on the body are reddish-brown, and the under surface is dirty yellowish-white, sometimes spotted with black. The head is large and flat, with a rounded blunt muzzle. Just behind the head are two eminences like split beans, the parotid glands, from which the acrid secretion may be pressed in a jet. This secretion is the "venom" of the toad, which, although not possessing the deadly properties ascribed to it by popular superstition, acts as a defence to the toad from carnivorous animals. A dog will not take a toad into his mouth, as this acrid secretion burns his tongue and lips. But animals that have been inoculated with it have not been affected. In spite of the common prejudice, toads are not only inoffensive, but of great service to man in destroying injurious insects and their larvæ. They live out of the water, except during the breeding season, in March or April. They inhabit shady places and remain hid during the day, coming out at night in search of food.

The toad feeds on insects and worms of all kinds, but will touch only a living and a moving prey; it remains motionless, with eyes fixed on its intended victim till it comes within reach of its tongue, which is darted out with extreme rapidity and accuracy; when it seizes a worm, it pushes it into the mouth with the fore feet till it disappears, and the animal is swallowed whole. Its motions are by a kind of crawl; when alarmed it stops and swells out the body, and sometimes makes short and awkward leaps. The eggs are laid in strings 3 or 4 feet long, and are deposited in the spring, two or three weeks later than those of the frog, the young being fully developed about the end of summer, when they come to land; they are smaller and blacker in all their stages than the young of the frog. The toad casts its skin at irregular intervals, and swallows the discarded integument at one gulp. The toad is capable of some domestication, and when kindly treated will come to the hand to be fed. It is long lived, attaining the age of forty or fifty years in some instances. During the winter it remains torpid in holes and crevices and under stones; and it is an established fact that it can live for a long time—a year or more—without food and with a very small supply of air. But the accounts which have been given of live toads being found embedded in solid stone or the heart of a tree were disproved by the careful experiments of Dr. Buckland (see "Curiosities of Natural History," by Frank Buckland). A toad when young may creep into a hole, from which when full grown it is unable to escape; but so long as the crevice by which it entered remains open, and allows of the entrance of air and insects, life may be sustained for a considerable period. In the middle ages it was believed that

> "The toad, ugly and venomous,
> Wears yet a precious jewel in its head."
> —*Shakespeare, "As You Like It."*

This notion arose apparently from the likeness in colour of the toadstone, as known to the ancients, to the toad, whence it got its name. The Plate prefixed to this volume contains illustrations not only of the Common Toad (fig. 1), but also of two other batrachians belonging to distinct families, but popularly called toads—the Surinam Toad (*Pipa americana*, fig. 2) and the Fire-bellied Toad (*Bombinator igneus*, fig. 3).

The Natter-jack (*Bufo calamita*) is the only other British species, and is found in Ireland; it occurs also in many parts of Europe and ranges to Tibet. It is not so abundant in this country as the common toad, and is rather local. It is more active in its habits and is found in drier situations. It is less than 3 inches long, of a yellowish-brown colour, clouded with dull olive, and there is a bright yellow stripe running along the middle of the back. It is less bloated than the common species, and the eyes are more prominent. The skin emits a strong odour of gunpowder. There are several other species of toads found in various parts of the world. The common toad of North America is *Bufo americanus*. They all agree generally in their habits with the common toad of Europe.

TOAD-FISH (Batrachidæ) is a small family of fishes belonging to the order ACANTHOPTERYGII. The species are small carnivorous fishes living on the bottom of the sea, near the coast, in the tropical and warmer temperate parts of the world. The toad-fishes are so named from their broad thick head, wide gape, usually naked skin, and repulsive appearance. In the genus Batrachus, which contains the majority of the species, the head, lips, and cheeks are frequently provided with small skinny tentacles. The first dorsal fin is short, formed by three stout spines; the second dorsal and the anal fin are low, soft, and long; the ventral fins are placed under the throat. The Indian Toad-fish (*Batrachus grunniens*) is found in the Indian seas, and is said to be eaten at Bombay. It is from 8 to 18 inches long. The American Toad-fish (*Batrachus tau*) is found on the Atlantic coast of the United States, and in the Gulf of Mexico and the West Indies, in shallow water or lagoons. Another species, *Batrachus didactylus*, is found in the Mediterranean. Another genus of the family, Thalassophryne, contains two species from the Atlantic and Pacific coasts of Central America. These are remarkable as being among the few fishes provided with poison-organs. The first dorsal fin has two spines, each of which, like a spine on the operculum, is hollow, and perforated at its base and tip; it communicates with a poison-sac situated at its base, immediately below the skin.

TOAD-FLAX (Linaria) is a genus of plants belonging to the order SCROPHULARIACEÆ. The species are herbaceous plants, natives of the colder and temperate parts of the Old World. They are distinguished by their personate corolla, the mouth of which is closed by a prominent palate, spurred at the base, and by the capsule opening by valves or teeth at the top. The Common or Yellow Toad-flax (*Linaria vulgaris*) is common in hedges, &c., in Britain. It has an erect stem, about 2 feet high, numerous glaucous linear leaves and terminal racemes of large flowers, which are usually yellow, sometimes milk-white, with an orange palate. The flowers sometimes display the phenomenon known as *peloria*, the corolla becoming regular, with five spurs instead of one. It abounds in an acrid oil which is almost empyreumatic. Taken inwardly, it induces nausea. It has been advised in dropsy, but most authorities disapprove of it. When united with milk, the juice is a poison to flies. The Ivy-leaved Toad-flax (*Linaria cymbalaria*) is a native of Europe, and is found chiefly on old walls. It grows abundantly in Italy and Sicily, and is found in Great Britain, but is probably not a true native. It has trailing rooting stems, five-lobed heart-shaped leaves, and pale blue solitary axillary flowers. *Linaria elatine*, with small yellow and purple flowers, is a native of Europe and Africa, and is found in chalky cornfields in Great Britain. Several other species are natives of Britain. Some of the species are cultivated in gardens for the beauty of their flowers.

TOAD-STOOL is the popular name for species of Fungi belonging to the genera AGARICUS and BOLETUS.

TOBACCO is the name of the dried and prepared leaves of *Nicotiana tabacum* and other species of the genus Nicotiana, order SOLANACEÆ, employed most extensively as a mild narcotic in almost all countries. The genus Nicotiana contains about fifty species, natives of tropical America and Eastern Asia, the majority being confined to America. They are herbs, rarely shrubby, with the large broad leaves and stems covered with viscid hairs. The calyx is tubular, bell-shaped, and five-cleft; the corolla is funnel-shaped or salver-shaped, with a five-lobed limb; the stamens are five, inserted on and included by the corolla; the ovary is two-celled, ripening into a two-celled capsule, surrounded by the persistent calyx, and opening by two or several valves for the escape of the numerous, very small, kidney-shaped, roughened seeds.

The best known species, and that most generally cultivated, is *Nicotiana tabacum*, a handsome plant 3 to 6 feet high, with large, oblong, lance-shaped, sessile leaves, most of which are decurrent, embracing the stem with their bases. The flowers are in a large terminal panicle; the corolla is rose or pink in colour, about 2 inches long, funnel-shaped, with a dilated throat. This species was extensively cultivated in America before the discovery of that continent by Europeans, and it has since been naturalized in many parts of the world. The great bulk of the manufactured tobacco of commerce is furnished by this species. See Plate.

Turkish and Syrian tobacco is furnished by the *Nicotiana rustica*, which is smaller in every respect than the preceding species, and differs greatly from it in other respects, the leaves

being more ovate in form, and proceeding from a thick stalk, while the flowers are of a greenish tint. It is a native of tropical America, but is cultivated in all quarters of the globe, especially in Northern and Eastern Europe. It grows more quickly, ripens earlier, and is more hardy than the common species. As its leaves in drying retain much of their colour, it is often called green tobacco.

Tobacco is now very extensively cultivated in Holland, Germany, France, Austria, Greece, and Turkey, as well as in India; but the tobacco of the United States and Cuba is still very generally admitted to be decidedly superior to most others. It is much higher flavoured than the tobacco of Europe; a superiority attributable in some degree, perhaps, to a different mode of treatment, but doubtless far more to differences of soil and climate. Cuba is particularly celebrated for its cigars. At one time the importation of the latter into this country was prohibited, and they were afterwards saddled with the exorbitant duty of 9*s.* per lb. This was reduced in 1863 to 5*s.*, and the consumption was doubled within four years.

In northern climates the tobacco seed is sown in hot-beds, and the plants are set in rows from 2 to 3 feet apart. In warmer countries the seed is sown in seed-beds of rich soil, having previously been mixed with sand or wood-ashes. Small branches of trees are then laid over, in order that the seed when it has budded may be protected from the frost; these, however, are removed as soon as consistent with safety, and the plants then grow rapidly, and are ready for transplanting in the fields in June. The plantations are very carefully prepared. Small hillocks, each about a foot in diameter, and flattened at the top, are raised up in rows; and with the first appearance of wet weather the plants are removed from out the seed-beds, and placed one by one on every hillock. The operation often lasts until July. When finished the workmen turn to weeding, and keep a watchful eye to prevent the ravages of insects. This duty is often performed by flocks of turkeys kept on purpose by the planters. As soon as the plants begin to throw out the flower shoot it is nipped off, that all the strength of the plants may be concentrated in the leaves. Such is the case, at least, on the principal plantations; but the process is neglected by the Turks and Greeks, who prefer small leaves, and by the planters of the Latakia tobacco, in which both leaves, buds, and flowers are used. The cutting operation is generally done by hand, and during the middle of the day; and only such plants are chosen as those in which a clammy exudation has formed over the leaf, giving it in many cases a spotted appearance, which shows that they are ready. If they be very large the stalk is split down to facilitate the drying. They are then taken to the tobacco house, where they are hung out on sticks to dry. After hanging some time they are removed, and the good leaves are separated from the bad. The chosen ones are tied up into bundles, and packed in hogsheads under an enormous pressure.

The manufactures of tobacco are very various. The plant is generally imported in the leaf, but small quantities pass through the manufacturing process. The principal variety, called *Cavendish*, is made by stripping the blades of the leaves from the midribs; and after sprinkling them with an infusion of tobacco made from the stalks and other waste parts, laying them in heaps to ferment and heat. By this process their colour is darkened; and while still in a moist and flaccid state they are laid smoothly one upon the other, forming cakes about 9 inches long and 3 inches broad, which are pressed by machinery until compact and firm. The *Negrohead* is formed into sticks of an inch thick and 8 or 9 inches in length, laid across each other equally, and then pressed into cakes. *Cigars* are also forms of manufactured tobacco. They are chiefly supplied from Cuba, the Havana tobacco being of an excellent quality. Their manufacture is extremely simple. A boy, with a quantity of unstripped leaves before him, takes them one by one, strips them, and then passes them to the cigar maker, who is seated in front of a low work-bench, which has raised ledges on every side excepting that nearest him. He takes a leaf of tobacco, spreads it smoothly before him on the bench, and cuts it in a form resembling one of the gores of a balloon. He then lays a few fragments of tobacco leaf in its centre, and rolls the whole up into something like the shape of a cigar, which is then placed in an iron gauge, and cut to a given length. The maker then lays a narrow strip of leaf upon the bench, and rolls the cigar spirally in it. All this is done with great rapidity, a few seconds being sufficient for the production of a cigar.

Tobacco is largely manufactured in this country. It is either cut finely, as convenient for immediate use, in the shape of "shag" or "bird's-eye," or made into cavendish, negrohead, or twist. The latter, often called *pig-tail*, is a continuous string of tobacco, about the thickness of a quill, made by twisting and spinning the leaves when flaccid. The string is then made up into balls, in which state it is chiefly used by those who chew tobacco. *Snuff* is another form of manufactured tobacco. See SNUFF.

The tobacco plants which were first introduced into England were found to answer remarkably well. Their cultivation was, indeed, prohibited by James I. and afterwards by Charles I., but apparently without effect, although during the earlier part of the reign of the latter the trade in tobacco was monopolized by the crown. This monopoly was not, however, of long continuance, and totally ceased at the breaking out of the Civil War. At length the growing consumption of tobacco having excited the attention of the government financiers, it was seen that, by imposing a duty on its importation, a considerable revenue might be raised; but that were it allowed to be freely cultivated at home it would be very difficult to collect a duty upon it. In 1643 the Lords and Commons imposed a moderate duty, for the sake of revenue, on colonial tobacco; but instead of directly prohibiting the use of native tobacco, they burdened it with such a duty as, it was supposed, would occasion its culture to be abandoned. The facility, however, with which the duty was evaded soon satisfied the government that more vigorous measures were required to stop its cultivation, and consequently to render its importation a source of revenue. Hence, in 1652, an Act was passed prohibiting the growth of tobacco in England, and appointing commissioners to see its provisions carried into effect. This Act was confirmed at the Restoration by the Act Charles II. c. 34, which ordered that all tobacco plantations should be destroyed. These measures were believed at the time to have been principally brought about by the solicitations of the colonial planters; but their real intention was not so much to conciliate or benefit them as to facilitate the collection of a revenue from tobacco; and, considered in this point of view, their policy seems quite unexceptionable.

This Act did not, however, extend to Ireland, and previous to 1830 the cultivation of tobacco made considerable progress in that country. A parliamentary committee then reported that "to continue the permission to grow tobacco in that country would encourage the native capital and labour at the expense of the revenue, and further that it encouraged smuggling." The permission was therefore withdrawn, and the Statute 1 and 2 Vict. 4 c. 13 made it penal to grow the plant in future.

In consequence of the long-continued agricultural depression in the United Kingdom, and the desirability of finding, if possible, other crops suitable for British and Irish farmers, permission was granted by the government in 1886 to cultivate the plant in the United Kingdom under certain somewhat severe restrictions, and the results were considered so far satisfactory that in 1887 permission

was granted to extend the experiments under less onerous restrictions.

So far as Europe generally is concerned there has been a great decrease in tobacco cultivation in recent years, except in France, where the government purchases the crop. In America, on the other hand, the growth of tobacco is increasing, and the annual yield from about 650,000 acres amounts to 500,000,000 lbs.

For many years the customs duty on unmanufactured tobacco stood at *3s. 2d.* per lb., but it was increased to *3s. 6d.* in 1878, and so remained until 1887, when it was reduced to *3s. 2d.* The present rates are as follows:—

	Per lb. S.	D.
Unmanufactured, containing 10 per cent. or more of moisture,	3	2
Unmanufactured, containing less than 10 per cent. of moisture,	3	6
Cigars,	5	0
Cavendish,	4	6
Other manufactured tobacco,	4	0

If any manufacturer of tobacco has in his custody any tobacco (except such as must undergo some treatment before it is fit for sale), or if a dealer is found with any tobacco which, on being dried at a temperature of 212 degrees, is thereby decreased in weight more than 35 per cent., he is liable to an excise penalty of £50, and to have the tobacco forfeited.

The price of tobacco in bond varies from *4d.* to about *1s.* per lb., so that the present duty of *3s. 2d.* per lb. amounts to 1000 per cent. on the inferior, and 300 per cent. on the superior qualities. Though so excessive, it is probably the least objectionable customs duty now on the tariff. The only reasonable argument that can be urged against the duty is that it is an incentive to smuggling and adulteration, which weighs for very little when contrasted with the enormous public revenue which the article produces.

The quantity of tobacco imported into the United Kingdom of course varies with the crop, which is of a somewhat fluctuating nature. The following are the most recent returns:—

UNMANUFACTURED TOBACCO.

	Total Imports.	Value.	Retained for Home Consumption.
	Lbs.	£	Lbs.
1884,	54,799,147	1,815,702	50,772,513
1885,	78,919,508	2,652,542	51,325,060
1886,	83,461,493	2,573,850	50,972,001

MANUFACTURED (CHIEFLY CIGARS AND CAVENDISH).

Year.	Total Imports.		Retained for Home Consumption.
	Lbs.	£	Lbs.
1884,	3,143,567	961,234	1,536,209
1885,	4,307,789	1,248,017	1,730,924
1886,	3,560,558	1,207,727	1,845,990

More than two-thirds of the unmanufactured tobacco imported is from the United States, where it is chiefly grown in the states of Maryland and Virginia. Smaller supplies are received from Holland, China, Japan, and India. Nearly the whole of the Cavendish is also received from the United States, but the largest quantities of cigars are imported from Cuba, the Philippine Islands, and Germany.

The consumption of tobacco in the United Kingdom has been as follows at different periods:—

Year.	Consumption.	Duty.	Population.	Consumption in ounces per head.
	Lbs.			
1821	15,598,152	*4s.*	21,282,960	11·71
1831	19,533,841	*3s.*	24,410 439	12·80
1841	22,309,360	*3s.* & 5 p. Ct.	26,833,496	13·21
1851	28,062,841	"	27,513,056	16 36
1861	34,673,789	"	29,036,508	18·60
1871	41,827,010	"	31,817,108	21·03
1881	49,322,697	*3s. 6d.*	35,241,482	22·28
1886	50,972,000	"	36,707,418	23

Tobacco and cigars are now almost the only articles which are ever attempted to be smuggled into Great Britain. To prevent this as much as possible severe penalties are inflicted for breaches of the law with regard to it, and no packet is allowed to be imported of less than 80 lbs. weight (except samples of 4 lbs. for trade purposes, only under specified regulations), nor in a vessel of less than 120 tons burden. Neither can it be imported from abroad except into ports duly approved by the commissioners of customs.

These regulations do not apply to small quantities of tobacco or cigars which passengers may bring with them in their luggage, in which case they may pay duty on any quantity of manufactured tobacco or cigars up to 3 lbs., if they have only arrived from the Continent and are not frequent passengers; but if from the East or West Indies, or other distant voyages, duty may be paid on any quantity not exceeding 7 lbs. in weight. Half a pound of cigars or manufactured tobacco is allowed to passengers duty free, provided they are not frequent visitors; but to those coming from the Channel Islands this privilege is limited to one-half the quantity. The revenue derived from tobacco in 1886 was £9,388,444, or nearly half the total amount (£20,148,971) obtained from all articles liable to customs duty.

The popular English name for tobacco was originally derived, *not* from Tobago, or any other geographical appellation, but from the native name of a peculiar, forked, hollow reed, in shape resembling the letter Y, which implement was called *tabaco* by the Indians of San Domingo, and used as a pipe through which to inhale the smoke of the burning leaves. In November, 1492, it may be said that Columbus, or rather a couple of his men, while exploring Cuba, first discovered tobacco, the natives having, as was imagined, a peculiar method of scenting themselves, for they carried lighted brands about with them, and emitted an odoriferous smoke from their noses and mouths; this smoke being derived from the burning of what might be called the "original cigar," a number of leaves of a particular plant rolled up in the sheaths of Indian corn or maize heads.

That the practice of smoking and chewing tobacco is a very ancient one we have abundant evidence, no single tribe of North American Indians being unacquainted with the custom, even when first noticed by European adventurers; and all the data at our disposal tend to show that "smoking" originated among "these wild untutored savages."

Upon the occasion of the Spanish invasion of Paraguay in 1503, one of the most powerful of the native projectiles was tobacco juice, which was dexterously squirted into the eyes of the invaders whenever they came to close quarters.

The solemnities of smoking now current in Turkey and the East are but a repetition of those in which the old Mexicans delighted, for the favourite ladies of Montezuma brought his yerba, scented water, and his pipe regularly after dinner; and Cortez, in 1519, acquaints us that tobacco had been used in Mexico for many centuries previously. We owe its introduction into Europe to the auspices of Gonzalo Hernando de Oviedo, by whom it was

first planted, and cultivated as an ornamental plant, in Spain. Its medicinal virtues were ascertained and extolled by Francesco Hernandez. Jean Nicot, of Villemain ("Master of the Requests" to the King of France), being accredited as ambassador to the court of Lisbon in 1559, bought some tobacco seed there of a Flemish captain just returned from Florida, some of which he sent to the grand prior of France. Upon Nicot's return in 1561 he presented some of the tobacco plants to Cathérine de Médicis, and suggested the names *Herbe Medicée* and *Herbe de la Reine* for the plant; these appellations, together with the native one *petun*, were applied indiscriminately for some time, but were superseded a little later by the shorter and more appropriate title of *Nicotiana*, which botanists have retained to the present day. Tobacco was introduced into Italy in 1560, and speedily became an article *de luxe*. The popes Urban VIII. and Innocent XI. fulminated against it the thunders of the church, and smoking was stigmatized by the sultans and the priests of Turkey as a crime, punishable in many instances by the most barbarous of deaths. In Turkey, too, the pipes of smokers were thrust into their noses; and in Russia, towards the early part of the seventeenth century, the noses of the smokers were cut off.

Tobacco was first brought to England by Sir John Hawkins in 1565. Sir Walter Raleigh and Sir Francis Drake are, however, mentioned as having introduced it in 1586. The Pied Bull Inn at Islington is said to have been the first house in England at which tobacco was smoked. At any rate, the plant found numerous advocates, and became extremely popular. It experienced here, however, the same virulent opposition as had been offered on the Continent. In 1584 a proclamation was issued against it. In 1614 the Star Chamber placed a duty upon it; and about fifteen years later we read that one necessary qualification of a teacher was that he should be no "puffer of tobacco."

It had the misfortune to attract the royal displeasure; and King James I. even issued a "Counterblaste to Tobacco," in which he described it as "a custom loathsome to the eye, hateful to the nose, harmful to the brain, dangerous to the lungs, and in the black stinking fume thereof resembling the horrible Stygian smoke of the pit that is bottomless." Ben Jonson, in his "Gipsies' Metamorphosis," had the prudence to abuse the object of the royal wrath, and in no measured terms. The play, therefore, took the fancy of the king, and was acted on three special occasions in his presence. In 1684 Charles II. forbade the cultivation of tobacco, and in the same year a duty was laid upon its importation. Several statutes were afterwards passed to the detriment of the "pernicious weed," but it still flourished.

In Spain, France, Germany, Holland, Great Britain, Sweden, Denmark, and Russia, the practice of smoking tobacco now prevails among the rich and poor, the learned and the gay. In the United States it is often carried to an excess, for it is not uncommon for mere boys to have a pipe or cigar in their mouth during the greatest part of the day. In Turkey the pipe is perpetually in the mouth; and the most solemn conferences are generally concluded with a friendly pipe, employed like the calumet of peace among the Indians. In the East Indies not merely all classes, but both sexes, inhale the fragrant fumes; the only difference among them consisting in the shape of the instrument employed, and the species of the herb smoked. In China the habit equally prevails; in fact, almost every Chinese female, from the age of eight or nine, wears as an appendage to her dress a small silken purse or pocket to hold tobacco and a pipe, with the use of which many of them are not unacquainted at this tender age.

The chief *constituents* of the tobacco leaf are mineral matter, or ash, which amounts to 15 or 16 per cent.; starch, sugar, gum, cellulose, and albumenoids, a poisonous volatile principle known as NICOTINE; chlorophyll, a concrete oil or resin; and, of course, a varying amount of water. In the process of manufacture there may be legitimately added water, molasses, sugar, salt, nitre, and various odoriferous substances; while as adulterants we have a list far too long for insertion here, including almost every convenient vegetable matter, from hay to hawthorn leaves.

There has been unlimited discussion respecting the injurious effects of smoking ever since the first introduction of tobacco, and a great deal of nonsense has unfortunately been urged by enthusiasts on both sides. Some have praised tobacco far beyond its merits; while others have so enlarged upon its injurious and poisonous qualities as to make one wonder that anybody who smokes should be left alive at all.

From a review of the scientific testimony and physiological facts bearing upon this subject, we may safely arrive at the following conclusions:—(1) That smoking in excess is decidedly an injurious habit, frequently causing dyspepsia and functional diseases of the heart, brain, and nervous system; (2) that smoking, even when in moderation, is pernicious in early life also to certain constitutions, and in particular conditions of the body; (3) that in adult life and in ordinary health no well-ascertained ill effects have been demonstrated as owing their causation to moderate smoking; (4) that the moderate use of tobacco is not only in many cases a harmless luxury, but occasionally, from its soothing and tranquillizing influence, a useful adjunct. Smoking, even in the strictest moderation, with some persons of peculiar idiosyncrasies, acts as a poison, and should therefore be avoided when feelings of discomfort are entailed by its use.

It is impossible to lay down any rule as to the amount of tobacco which may be consumed without a deleterious effect upon the health. What would be moderation to one is often excess to another, according to temperament, habit, and individual peculiarities. Each person ought to be able to judge for himself as to what is moderation. The best time for smoking is undoubtedly after a meal; and the most injurious, on an empty stomach.

Although formerly supposed to possess countless medicinal virtues, tobacco is now but little employed in the healing art. The only preparation containing it which now appears in the British Pharmacopœia is the *Enema tabaci*, obtained by infusing 20 grains of leaf tobacco in 8 fluid ounces of boiling water. Its rare use is chiefly due to its extremely dangerous character, so small a quantity as half a drachm infused in water having proved fatal.

TOBA'GO, an island in the West Indies, is the most southern of the Windward Islands, and lies about 20 miles north from Trinidad. Its greatest length is 32 miles, greatest breadth about 13 miles; and area, 97 square miles, or 62,080 acres. The population in 1881 was 18,051. The rainfall in Tobago is plentiful, and the soil is extremely fertile. The planters confine their attention almost exclusively to the cultivation of sugar and the manufacture of its collateral products—rum and molasses. Cocoa-nuts, cotton, coffee, indigo, and pimento are also grown, but only to a very limited extent. Cattle and horses, mules and asses, thrive well; and the ponies of the island are hardy little animals.

The capital and chief port is Scarborough, on the north. Most of the foreign commerce is with Great Britain. The revenue and expenditure are about £12,000 per annum. The former is almost entirely derived from customs duties. The reputed unhealthiness of the climate is a mistake. The population is described as happy and contented; but, as a rule, the negroes are not steady workers upon daily wages. The colony, which is divided into seven parishes, is under the authority of a lieutenant-governor, assisted by a privy council and House of Assembly.

Tobago was discovered by Columbus in 1496, and derives its name from the universal habit indulged in by the natives of smoking the leaves of the tobacco-plant. At an early period the British flag was planted on the island, and James I. granted it to the Earl of Pembroke; but no attempt was made by the English to colonize it. In 1632 the Dutch formed a settlement here, and it was afterwards in the possession of the Spanish, British, and French. In 1763 the English again obtained possession of it, and by them it has been held ever since. When the West India slaves were emancipated in 1834, those of Tobago numbered 11,589, for whose emancipation the sum of £233,872 was paid. The white inhabitants at that time amounted to less than 300.

TO'BIT, BOOK OF, one of the books of the Septuagint accepted as canonical by the Roman Catholic Church, but which is placed by Jews and Protestants among the Apocrypha. It exists at present in Greek, Latin, Syriac, and Hebrew texts, which have the appearance of being derived from one written original, though they differ from each other in detail. The period at which it was written and the place of its composition are unknown, and the estimates of modern scholars vary considerably concerning both points, but the internal evidence seems to favour the opinion of Ewald, who fixes the composition in the far East, towards the close of the Persian period, or about the middle of the fourth century B.C. If this view be correct the original work must have been written in Hebrew or Chaldee, but the earliest existing text is the Greek of the LXX. The book was for a long time regarded as canonical in the Christian church, and the truth of the narrative it contains was accepted without inquiry or dispute until the time of the Reformation, when Luther placed it among the "poetical" books, rejecting its authority, but commending it at the same time as "a truly beautiful, wholesome, and profitable fiction, the work of a gifted poet." Most Protestant scholars follow the opinion of the great reformer, and while they reject the canonicity of the book, they give it a high place among those works of the ancient Jews which are "profitable for Christian reading."

TOBOLSK', a town of Russia, in Siberia, the capital of the government of the same name, is situated at the junction of the Tobol with the Irtisch, 1976 miles east of St. Petersburg. It is divided into the upper and the lower town; the former, on the east bank of the Irtisch, is on a hill, which runs parallel to the river, at a small distance from it; the latter, which is the larger, fills the space between the hill and the river, and is exposed to inundations. The communication between the upper and lower town is by a gently-rising causeway paved with planks. Tobolsk is well built with timber houses, has wide, regular streets, and is much frequented, being on the commercial route between European Russia, Further Siberia, and China. It is the residence of the governor-general of Western Siberia, the see of a Russian archbishop, who is the metropolitan of all Siberia; has a theological seminary, a training school, some printing-offices, and a theatre. The only manufactures of importance are those of soap and Russian leather; the Russian and Tartar women also make linen, carpets, and woollen cloth. The principal public buildings are—the cathedral, with five cupolas; about twenty other churches, some mosques and convents, the archbishop's and governor's palaces, and the public offices. The population in 1883 was 20,132.

TOCQUEVILLE, ALEXIS CHARLES HENRI CLÈREL DE, a political philosopher of great renown, was born at Verneuil, in France, in 1805. His mother was a granddaughter of Malesherbes, the eminent lawyer; his father, a peer and prefect under the Restoration, wrote two philosophical works on the history of France during the reigns of Louis XV. and Louis XVI. De Tocqueville was educated at the college of Metz, where he distinguished himself in French composition. Having passed through the usual legal studies he was appointed, in 1827, *juge auditeur* to the Versailles tribunal, where his father was prefect, and where his colleague was his trusty friend and eventual biographer, Gustave Elie de Beaumont. The revolution which seated Louis Philippe on the throne directed his attention to the probable workings of democracy; and the question of prison discipline being at the same time prominently brought before the government, he was offered an official mission to the United States with reference to the latter, which at the same time enabled him to pursue his inquiries upon the former subject. Accompanied by his friend De Beaumont, he crossed the Atlantic in 1831, remained in America a twelvemonth, and on his return to France in 1832, published, in conjunction with De Beaumont, a treatise, "Du Système Pénitentiaire aux Etats Unis," which produced important improvements in the penal discipline of France. In January, 1835, appeared the first two volumes of the remarkable work by which he will be known to posterity, "La Démocratie en Amérique," a sagacious and impartial exposition of the working of American democracy for good and evil, many of whose conclusions have been singularly confirmed, and many of whose predictions verified by the course of events in the great civil war. De Tocqueville now visited England, where he was warmly received, and where he married a young English lady in 1835. The concluding volumes of his great work were given to the world in 1840, and in the following year his merits received the highest recognition which the French world of letters can bestow, by his election to a chair in the French Academy. He now distinguished himself in the Chamber of Deputies by his speeches on social and administrative reform, and when Napoleon III., at that time prince-president, formed his cabinet in 1849, he accepted the office of foreign minister. In this capacity he committed the grave error of supporting the policy which dictated the expedition to Rome and placed a French army in the Eternal City. It cannot be doubted that in adopting a course so prejudicial to the interests, rights, and feelings of the Italian nation, he was actuated by the narrow partisanship of an ambitious Frenchman rather than by the political foresight of a liberal-minded statesman. He resigned his office in about four months, warmly protesting against the *coup d'état* which gave his country an imperial *régime*, and, after suffering a brief imprisonment, retired into private life. His last work, a sketch of the causes which produced the great catastrophe of 1789, "L'Ancien Régime et la Révolution," appeared in 1856. He died at Cannes, 16th June 1858. His "Œuvres et Correspondance Inédites" were published in 1860, with a biographical preface by his friend De Beaumont, and an English translation appeared in the following year. The "Democracy in America" was rendered into English by Mr. Henry Reeve.

TOC'SIN, an alarm-bell. The origin of the word is uncertain, but since the use of the tocsin to summon the mobs of Paris, during the excesses of the French Revolution, it has become proverbial.

TOD'DY is the juice which flows from the spathes of the cocoa-nut, date, and various palms when they are cut or wounded. When fresh it forms a most agreeable beverage, and is employed by the Hindu bakers instead of yeast in the preparation of bread. It is also distilled into a spirituous liquor, which is drunk by the natives under the name ARRACK. The name toddy is also given to the national drink of the Scotch, a mixture of whisky, hot water, lemon, and sugar.

TOD'LEBEN, FRANZ EDWARD, COUNT, a distinguished Russian general of German extraction, the son of a merchant of Courland, was born in 1818. He entered the school of cadets at Riga in 1829, and in 1842 became an officer in the engineers, after which he was employed

in constructing the fortifications of Kiev. He fought against the Circassians from 1846 to 1848. Todleben was captain at the outbreak of the Crimean War in 1854, and after serving in the Danube went to the Crimea, where by his skill and promptitude in meeting the besiegers of Sebastopol on the south side with fortifications of enormous strength, erected after the siege had commenced, he baffled the attacks of the bravest English and French troops, delayed the capture of the city, and, it is hardly too much to say, saved the credit of his country. He conducted the defence in person, and was severely wounded in the foot; nevertheless, after the fall of Sebastopol he went northwards, inspected the fortress of Nicolaiev, and strengthened the defence of Cronstadt. Todleben had now obtained high repute as an engineer, and was made a general. After the peace he served as aide-de-camp to the Grand-duke Nicholas, wrote a "Narrative of the War in the Crimea," and visited England in 1865. After General Krudner's failure to take Plevna by storm during the Russo-Turkish war of 1877, owing to the gallant resistance of Osman Pasha, General Todleben was summoned to the front, and proceeded to reduce the place by investment. The Turkish general was compelled to surrender on 9th December. In April, 1878, for the last weeks of the war, he replaced the Grand-duke Nicholas as commander-in-chief of the Russian army in Europe, and was then made a Count. He was governor of Odessa from 1878 to 1880, but spent the last years of his life in retirement, dying in 1884.

TODMOR'DEN, a market-town of England, in the counties of Lancaster and York, and a seat of extensive and flourishing manufactures, is 208 miles from London. It is a station on the Lancashire and Yorkshire and the Manchester and Leeds Railway, and is also situated on the Rochdale Canal. It stands in the narrow mountain pass through which the river Calder flows down from the Lancashire hills into Yorkshire. The inhabitants are engaged in cotton and woollen manufactures, iron-foundries, and in the working of quarries and coal mines. There are two episcopal chapels, both of modern date, and also several dissenting places of worship, the most remarkable of which is the splendid Unitarian church, erected in 1869 by Messrs. Fielden, as a memorial of their deceased father, through whose exertions the Factories Act was obtained. It is an elaborate Gothic structure, with a tower and spire rising to a height of 190 feet. In 1875 the same gentlemen presented a handsome and costly town-hall to the inhabitants, and in front of it is a memorial bronze statue of their father. The population in 1881 was 23,862.

TO'DY (Todus) is a genus of birds belonging to the order VOLITORES, family Todidæ. The species are very few, all inhabitants of tropical America and the West Indies. The todies are distinguished by having an elongated bill, which is exceedingly broad and depressed towards the base, so that it acquires a tongue-like shape. The margins of both mandibles are finely denticulated. The tarsi are of moderate length and slender. The outer toe is nearly as long as the middle one, to which it is united for three-fourths of its length; the inner toe, which is considerably shorter, is also united to the middle one for half its length. The Green Tody (*Todus viridis*), the best known species, is a very small bird, being little bigger than a wren; the whole upper surface is of a vivid green colour; the throat is brilliant crimson, and the remainder of the plumage of the lower surface white. This bird is exceedingly common in all parts of Jamaica, which appears to be its headquarters; it feeds exclusively upon insects, which it usually captures while hopping about upon the twigs of trees. It is bold, allowing a person to approach it very closely, and if disturbed usually flies off to another twig only a few yards distant. Its brilliant green plumage and crimson throat render it the admiration of all visitors to Jamaica. The nest is formed in a burrow excavated in a dry bank, to a depth of about a foot, entirely by the agency of the bird's bill and feet; its course is somewhat tortuous, and at its extremity is a large chamber, which the bird lines with the dry fibres of plants, moss, and cotton for the reception of its eggs. The latter are four or five in number, of a gray colour, spotted with brown.

TO'GA is the name given to the principal outer garment of the Romans, which in times of peace they wore both at home and abroad. Hence they are called Gens Togata, in contradistinction to other nations. The right of wearing the toga was the exclusive privilege of Roman citizens of every age and sex. Slaves, foreigners, and Romans sent into exile were not allowed to wear it. As it covered the whole body with the exception of the left arm, it could not be worn by a person while at work either at home or in the field. It was wound round the body in a fashion somewhat akin to that in which a Highlander disposes his plaid, but looser, and unlike the plaid it was left at its full width and not folded: it therefore fell down to the feet.

The material of which the garment was made was woollen cloth, differing in thickness and fineness according to circumstances and the seasons. Under the empire persons of rank used to have their togas made of silk. The colour was usually white, probably the natural colour of the wool. As early as the time of Augustus, many Romans had left off wearing the toga, and taken to a kind of cloak called *lacerna*. This induced the emperor, who was fond of restoring ancient customs, to enjoin the ædiles to see that no Roman should appear in the forum or circus without the toga.

Toga prætexta was the robe worn by noble girls until they married, and by boys until they attained the age of fourteen, when they exchanged it for the *Toga virilis*, also called *pura*, *libera*, or *recta*, which was the usual white toga described above. The prætexta, with a broad purple border (*latus clarus*), was also the official robe of the higher magistrates of the city and the municipia, as well as of the colonies.

TOG'GENBURG or **TOCKENBURG,** a district in the canton of St. Gall, Switzerland, formed by the long and fertile valley of the Thur. It is thickly peopled by an industrious race, who manufacture cotton and muslin. Wildhaus, in this district, is a little mountain village 2000 feet above the level of Lake Zurich, famous as the birthplace of Ulrich Zwingli, the Swiss reformer. Toggenburg was formerly governed by counts of its own, who were among the richest and most powerful landowners in the country. In 1436 their possessions passed to the barons of Rasen, who in 1469 sold them to the Abbot of St. Gall. In 1803 they were included in the canton of that name.

TOISE, an old French measure of length, containing 6 French feet, or 1·949040 metres, and equivalent to 6·3945925 English feet.

TOKAT' or **TOCAT,** a large open town of Asia Minor, situated in about 40° 16′ N. lat., 36° 45′ E. lon., with a population estimated at 40,000. It is surrounded by hills on three sides, the only opening being to the north-east; a small stream runs through the town, and joins the Tokat-Su (ancient *Iris*) a little below the city. The houses are all tiled (*i.e.* not flat-roofed), and the better class of them built with unburnt bricks, but the greater part are merely wooden sheds. Most of the streets are filthy, narrow, and gloomy, but some of the edifices are of good size, and parts of the place are tolerably neat for a Turkish city. Fires are frequent. The luxuriant vegetation of the gardens in and near Tokat, the filthiness of the streets, the abundance of fruit, and the almost intolerable heat, in consequence of the town being so surrounded by hills, occasion malignant fevers in summer and autumn. The city is the seat of the Armenian bishop. It was formerly a place of considerable trade, but its importance in this respect has declined. There is still, however, an extensive

dyeing establishment and a large government refinery, to which copper from the mines near Diarbekr is brought, by means of mules and camels, to be refined. There are also some silk factories. Madder and yellow berries are extensively grown in the neighbourhood.

TOKAY', a town of North-east Hungary, on the right bank of the Theiss, at the influx of the Bodrog, 113 miles north-east by east from Pesth, with a population of 5000. It has a Roman Catholic cathedral, Lutheran, Reformed, and Greek United churches, and Piarist and Capuchin convents. It is celebrated as being the entrepôt for the famous Tokay wine, produced in the hilly district called the Hegyalla, between the Bodrog and Hernad rivers. Most of the wine of premier quality is bought up for the imperial cellars, and only the secondary and inferior growths are exported. The vineyards lie to the west of the Bodrog, and they occupy a space of 10 square miles. The soil is of yellow chalk, mixed with large pebbles. The wine is white, and the vintage is commenced as late in the year as possible, so that the grapes may become fully ripe, but generally at the end of October. The best wine is made by placing the grapes, when cleared of all rotten fruit, in a wooden vat with a double bottom, the top one being pierced with small holes. The vat is filled with grapes and covered with boards. After a few hours the fruit becomes heated to 80° Fahr., and fermentation sets in. The fermentation destroys the tartaric acid, and the weight of the grapes forces the juice through the holes in the bottom. They are then trodden under foot, and the wine is poured into small casks, where it remains to be exposed to the air for a month after having fermented for two days. When of good quality and ready for use, it has a silvery, oily colour, the taste is sweet and mellow, with a peculiar earthy flavour, slightly astringent and aromatic, with a good body. This wine may be preserved for an almost indefinite period, and it is not drinkable until it is three years old. Inferior Tokay is made by mixing a small quantity of the genuine wine with others of a somewhat similar character. The best Tokay is in great repute on the Continent for its restorative and tonic qualities, but, as before stated, it is exceedingly difficult to obtain it. The vine gathering is celebrated as a national *fête*. Besides the peculiarity of the soil, the general excellence of the wine is also to be partly attributed to the strongly contrasted summer and winter seasons in the district, and to the vineyards occupying sunny slopes of considerable elevation.

TOKENS are those substitutes for true coins whose value is conventional, not real. When the silver penny became scarce in the England of the middle ages, tokens of a penny, halfpenny, and a farthing were largely struck, not only by government, but by the people themselves. Antiquaries have them by numbers in copper, brass, pewter, lead, and even leather. As soon, however, as copper coinage took the place of silver for the penny it was made criminal to issue tokens privately. The government old copper coinage and the present bronze coinage to a still greater degree are token-coins, since their nominal value is far above their actual value as bullion. The silver coinage is to some extent token coinage, but is much more nearly to value than the bronze.

Therefore, since the government only issues these coins by virtue of its own credit a provision is granted, to prevent loss to traders, that more than 40*s*. in silver coinage is not a legal tender. Over that amount gold may be demanded. The first issue of token money in large quantities was at the mint for copper farthings, started in 1635 by patent in Lothbury, behind the present Bank of England; the fact being perpetuated in the familiar name of Tokenhouse Yard.

TOKI'O, formerly called *Yeddo* or *Jeddo*, is the capital of Japan, and the largest city of the empire. It is situated on the south-east side of Niphon, at the upper extremity of an inlet 20 miles long, which forms its harbour; a harbour equally capacious and secure, owing to the narrowness of its entrance and the number of small islands which break the roll of the Pacific. The actual port is at Kanagawa, 16 miles nearer the mouth of the inlet. The establishments of the foreign merchants are planted at Yokohama, a neighbouring town, which has a quay and pier of granite.

The city of Tokio stands second only to London in point of extent, its area being approximately computed at 36 square miles. Until recently its population was considered almost equal to that of London, but a census taken in 1879 showed the numbers to be 1,036,771 inhabitants, dwelling in 236,961 houses. The military quarters include the Mikado's palace, covering nearly a square mile of ground, and also the various government departments, and such residences of ex-daimios and hatamotos (the nobility and gentry of Japan) as were not taken possession of by government on the abolition of the feudal system. The business quarter, to the east of the castle, is divided into seventy-eight districts, which can be isolated by large wooden gates always guarded by policemen.

A fine view is obtained from the summit of a hill called Atango-gama, so called from the god Atango, to whom a temple is dedicated there. The picture that from this point breaks suddenly upon the traveller is very striking. The hill fronts to the bay, but with a couple of miles of valley intervening, thickly covered by streets and temples. To the left, and in a north-eastern direction, another 10 miles' interval of plain is in like manner filled up with a dense mass of houses, until the eye reaches a range of heights crowned by the castle. As far as the eye can reach the countless dwellings stretch away into space in monotonous straight lines of gray roofs, only broken here and there by the heavy eaves of some temple, and by the high black wooden watch-towers which are used during the fires which from time to time consume a square mile or so of the town. These fires and the frequent earthquakes account for the fact that in the whole of Tokio, giant city as it is, there are scarcely a score of large or ancient buildings to be seen.

The most populous part of the city is intersected by the river Okawa, which is spanned by a great central bridge. From thence are measured all the distances throughout the empire. Public baths are numerous and well frequented. In the suburbs tea-houses and gardens abound, and long lines of booths enliven the streets. The grand street of Tokio is 50 paces wide, and runs from north-east to west through the city for a distance of 12 miles. Beyond these points the road is continued northward to Hakodadi, and southward to Nagasaki, forming a continuous road, which compares favourably with English roads, of nearly 1000 miles in length. Tokio has railway communication with Yokohama, Osaka, and Hiogo.

TO'LAND, JANUS JUNIUS, changed afterwards to JOHN, a celebrated English deist, was born of Roman Catholic parents at Redcastle, Ireland, 30th November, 1670. He was first educated at Redcastle, and afterwards studied at the universities of Glasgow, Edinburgh, Leyden, and Oxford. At Edinburgh he abandoned the Roman Catholic faith, and also in 1690 secured his degree of M.A. In 1696 he published anonymously his most famous work, "Christianity not Mysterious," which caused immense excitement in the theological world. It was censured by Convocation, and it called forth numerous replies, among the ablest of which were those of Payne and Stillingfleet. In 1697 Toland visited Ireland, having first sent before him a large number of copies of his book, but in Ireland the opposition he experienced was more determined and dangerous than that which he had encountered in England. His book was publicly burned by the common hangman in obedience to the vote of the Irish Parliament, and some fierce polemics hinted that it would

be a good deed to serve the author in like manner. Toland, who was a man of extravagant vanity, was at first delighted at the uproar he had caused, but after a time he became alarmed and returned to London, where he turned his attention to political pamphleteering. His after-life was that of a literary adventurer, and under the pressure of want he accepted any piece of work that he could obtain from the booksellers. Some of the details of his struggles are given by D'Israeli in his "Calamities of Authors." Among his numerous writings the more important are his "Life of Milton" (1698); "Anglia Libera" (1701); "Socinianism truly Stated" (1705); "Reasons for Naturalizing the Jews" (1714); and "Nazarenus: or Jewish, Gentile, or Mohammedan Christianity" (1718).

He died at Putney, 11th March, 1722. His posthumous works were published in two vols. 8vo in 1726, with a life by Des Maizeaux. For a good account of his position in connection with the religious history of his period, see Hunt's "Religious Thought in England" (vol. ii. London, 1871).

TOLE'DO (*Toletum*), the capital of the province of Toledo in Spain, 40 miles S.S.W. from Madrid by railway, is situated on a rocky eminence 2400 feet above the sea, and surrounded, except on the northern side, by the Tagus. The Tagus forms a great natural fortress around three sides of the town, and the only approach by land is well defended. It was a city of some importance under the Romans, and there are still the remains of an amphitheatre, and some of the walls. In 577 Leovigild, king of the Goths, transferred the seat of his empire from Seville to this place. It was also greatly enlarged and embellished by Wamba, who surrounded it with walls. The city was taken by the Moors under Tarik Ibn Zeyyad, in April, 712. Under them it was second only to Cordova, the capital of the Mohammedan Empire. Alfonso VI. of Castile and Leon retook it on the 25th of May, 1085, and having assumed on the occasion the title of Emperor of Toledo, the city was thenceforward styled royal and imperial. In the height of its prosperity the town is said to have contained 200,000 inhabitants. Between the fifth and ninth centuries it was the seat of several general ecclesiastical councils. Its decay was owing to the removal of the court to Madrid under Philip II. The present population is only about 20,000.

Toledo is the see of an archbishop, who is the primate of all Spain, and bears the title of "Canciller de Castilla." The cathedral is the largest, and is by some considered the finest, in Spain. It stands on the site of the old Moorish mosque, and the foundations were laid in 1258 by St. Ferdinand and Rodrigo Ximenez, the then archbishop. It consists of five naves, and measures 404 feet in length and 204 in width; the central nave is 160 feet high, and the whole interior is lighted through painted glass windows of matchless beauty. The naves are supported by eighty-four colossal pillars, and the whole church is paved with white and blue marble. It has a lofty tower and spire. The choir, occupying the central part of the great nave, and some of the chapels, which are exceedingly beautiful, contain many monuments of the kings and nobles of Spain, and are deserving of notice for the profusion of exquisite carvings in wood, marble statuary, and decorations with which they abound. Annexed to the cathedral is the archbishop's palace, which contains a very fine library, rich in old manuscripts. The convent and church of San Juan de los Reyes is a fine building, erected in 1476 by Ferdinand and Isabella, in commemoration of the victory gained over the Portuguese at Toro. At a later period the manacles and fetters worn by the Christian captives of Granada, liberated at the taking of that city in 1492, were suspended to the outside walls of the building, where they are to be seen to this day. The foundling hospital of Santa Cruz, established by Cardinal Mendoza in 1304; the hospital of St. John the Baptist, outside the city walls, built and richly endowed by Cardinal Tavera; San Juan de la Penitencia, which is a foundation of Ximenez—all afford subjects of study to the artist. The Church del Transito, formerly a Jewish synagogue, is a curious specimen of Saracenic architecture. The same may be said of another church, called Santa Maria la Blanca, which was once a Moorish mosque.

The Alcazar, or royal palace, which stood on an eminence above the Tagus, was burnt by the French in 1808. It was afterwards restored at a cost of £200,000, but was unfortunately again burnt in 1887. It was originally built by Alfonso X. on the site of the Moorish palace, and almost entirely rebuilt by Charles V., who employed the best Spanish architects of his time. A lunatic asylum, called "el Nuncio nuevo," and the "Universidad Literari," are the only two modern buildings of note; both were erected by Archbishop Lorenzana, about the end of the last century. The Zocodova, or "square market," a fashionable resort, is altogether Moorish in its architecture. Here heretics were formerly burnt and bull fights took place. Among the other public buildings are the university, four colleges, numerous hospitals and asylums, a town-hall, and a mint. Of the two bridges over the Tagus, that of Alcantara, which is fortified, was built by the Moors. It consists of only one arch. Although on approaching it Toledo has from its position a very imposing appearance, the streets are narrow, crooked, and badly paved. The houses, which are built in the Moorish style, have generally only one or two storeys; and the apartments are arranged round a court, over which an awning is thrown. Spanish manners and customs may be observed in greater purity in Toledo than in any other town in the country. The climate is exceedingly hot in summer, and, on the other hand, very cold in winter. The immediate environs of the city are barren and unproductive, but the neighbouring mountains contain some green valleys, where the wealthy inhabitants have their country houses. During the fifteenth and sixteenth centuries this town was celebrated for its sword-blades as well as for its silks; the fabrication of the former still continues under the patronage of the government, and the weapons produced are of the very best description. Manufactures of coarse woollens, paper, guitar strings, coarse glass, and leather, are also carried on.

TOLE'DO, a flourishing city of the United States of America, in Ohio, at the western extremity of Lake Erie, is pleasantly situated upon an elevated plain on the banks of the Maumee River, about 4 miles from its mouth. It is 134 miles W.N.W. of Columbus, 112 west of Cleveland, and 65 from Detroit. The river affords a spacious, safe, and beautiful harbour for the largest steamers and vessels. The town has also numerous canals and railways, and its depot and warehouse accommodation is unique and extensive. The exports are principally flour, pork, beef, cattle, hides, wool, tobacco, and timber. There are numerous establishments for working wood and iron, and for making flour, tobacco, beer, flax, cotton, and chandlery; and there are extensive waggon works and shipbuilding yards. Toledo contains numerous churches, banks, an orphan asylum, many artesian wells, several miles of paved streets, and a street railway. The buildings for the public school, which is open to all, are the best in the town. The site was formerly unhealthy, and the inhabitants suffered much from malaria; but the causes of this are now removed, and the place in 1880 had a population of 50,143. In 1840 it had 1322; in 1850, 3829; in 1860, 13,768; and in 1870, 31,584.

TOLENE, the oil from balsam of Tolu, *Myrosperum toluiferum*, natural order Papilionaceæ. It is a colourless mobile oily hydrocarbon, having the specific gravity 0·858, and the formula $C_{10}H_{16}$. It boils at 160° C. (320° Fahr.)

TOLERATION, ACT OF, is the name given to an Act of Parliament passed in 1689, the first year of the reign of William and Mary, to relieve Protestant dissenters from certain penalties. Persons taking the new oaths of allegiance and supremacy, and making a declaration against transubstantiation, were thereby exempted from the penalties incurred by absenting themselves from church, or by frequenting unlawful conventicles. Dissenters were restrained from meeting with locked doors; but on the other hand a penalty was enacted against disturbing the congregation. The ancient penal statutes remained, however, unrepealed; and persons who denied the Trinity, as well as Roman Catholics, were excluded from the benefit of the new Act. An attempt was made at the same time to pass a comprehensive bill, in order to admit dissenters by altering the liturgy, and leaving certain ceremonies discretionary; but it failed, and has never since been renewed. The clause of the Toleration Act which excepted antitrinitarians from its privileges was repealed in 1813.

The provision of the Tests and Corporation Act, however, still remained, by which all Protestant dissenters taking any office were compelled to partake of the sacrament of the Lord's Supper according to the rites of the Church of England; but this disability was removed by the 9 Geo. IV. c. 17. Another concession was made by the Act of 15 & 16 Vict. c. 36, whereby dissenters were allowed to certify their places of worship to, and register them with, the registrar-general of births, deaths, and marriages, instead of the archbishop, bishop, or court of quarter-sessions.

The benefits of these various Acts of toleration were, however, limited to Protestant dissenters, and in no way extended to Roman Catholics, with respect to whom the progress of emancipation was slower and more reluctant. By the statutes of 18 Geo. III. c. 60, 31 Geo. III. c. 32, and 43 Geo. III. c. 30, most of the severer penalties and disabilities to which they had been subject were removed; and by 10 Geo. IV. c. 7, generally known as the Catholic Emancipation Act, Roman Catholics were restored to the enjoyment of all civil rights, being excluded only from holding ecclesiastical offices and various high appointments in the state. A subsequent Act, 2 & 3 Will. IV. c. 115, provided that Roman Catholics should be subject in these particulars to the same laws as applied to Protestant dissenters. And finally, by the Acts of 7 & 8 Vict. c. 102, 9 & 10 Vict. c. 59, and 21 & 22 Vict. c. 48, both Roman Catholics and Jews were relieved from all enactments calculated to oppress them, and are thus practically admitted to all the privileges of the constitution. All Irish appointments, except the lord-lieutenancy, are now also thrown open to Roman Catholics.

In Scotland toleration in religious matters is secured by various old Scotch statutes passed before the union with England, particularly by the Act of 1690, c. 27, which repealed a number of former repressive Acts. The Act 10 Anne, c. 7, still further extended toleration. This Act has, however, been repealed by the Acts 34 & 35 Vict. c. 48, and toleration in religious matters in Scotland now rests largely on common law, and on statutes applicable to the United Kingdom.

TOL'STOI, ALEX'IS CONSTANTIN'OVICH, COUNT, a Russian dramatist and poet, was born in Russia Minor in 1818. He travelled largely in early years, and gained the friendship of Goethe, who predicted a great future for him. In the Crimean War he served in the Russian army. Among his principal works are the epic narratives, "The Sinner" (1858), "The Dragon" (1875); the historical novel, "Prince Serebrennyi" (1863); and the dramas, "The Death of Ivan the Terrible," "Tsar Fedor Ivanovitch," and "Tsar Boris." The first of these and the novels have been translated into English, and a selection from his poems, of which a complete edition appeared in 1878, has been translated into German. Count Tolstoi (who must not be confused with the living novelist and social reformer, Count Lyof Tolstoi) died in 1875.

TO'LU BALSAM. See BALSAMS.

TO'LUENE or **TOLUOL,** or **BENZYLIC HYDRIDE,** a hydrocarbon present in considerable quantity in coal-tar naphtha, from which it is usually obtained by distillation. That portion which distils over, between 100° and 120° C. (212° and 248° Fahr.), is collected and agitated with sulphuric acid, and redistilled; the portion distilling between 108° and 110° C. (226° and 230° Fahr.) is again collected. The boiling point of pure toluene is 110° C. It is a colourless hydrocarbon, having the formula C_7H_8, and the specific gravity 0·865. It is much used with benzine in making a mixture of aniline and toluidine for the various coal-tar colours.

Toluene combines with bromine, forming monobromotoluene (C_7H_7Br) and dibromotoluene ($C_7H_6Br_2$). The former is a colourless liquid, having a specific gravity of 1·409, and boiling at 183° C. (361° Fahr.); the latter is a liquid which decomposes on distillation.

Chlorine gives several derivatives with toluene, of which the most important are monochlorotoluene (C_7H_7Cl), dichlorotoluene ($C_7H_6Cl_2$), trichlorotoluene ($C_7H_5Cl_3$), and tetrachlorotoluene ($C_7H_4Cl_4$). Chlorotoluene boils at 164° C. (327° Fahr.), and has the specific gravity 1·080. Dichlorotoluene is not known in the pure state, but chlorobenzilic chloride, which is isomeric, boils about 200° C. (392° Fahr.) Trichlorotoluene has not been isolated; tetrachlorotoluene crystallizes in needles.

Nitrotoluene ($C_7H_7NO_2$) is obtained in white crystals, which melt at 54° C. (129° Fahr.), and sublime unchanged at 238° C. (460° Fahr.) Trinitrotoluene, $C_7H_5(NO_2)_3$, crystallizes in white needles. Both are obtained by the action of nitric acid on toluene, and are employed in the manufacture of toluidine for the coal-tar colours.

TOLU'IC ACID, or **TOLUYLIC ACID** is obtained from bromotoluene by the action of metallic sodium. It is soluble in boiling water, and crystallizes in needles on cooling. It melts at 175° C. (347° Fahr.), and sublimes without decomposition at a higher temperature. The formula is $C_8H_8O_2$. It forms crystallized salts with bases called toluates, and having the general formula $C_8H_7MO^2$. With nitric acid it forms nitrotoluic acid $C_8H_7(NO_2)O_2$, which crystallizes in yellow rhombic prisms; and forms crystalline salts with bases, called nitrotoluates, having the general formula $C_8H_6M(NO_2)O_2$. Toluic ether, or ethylic toluate, $C_8H_7(C_2H_5)O_2$, is a colourless oily liquid, boiling at 228° C. (442° Fahr.)

TOLU'IDINE or **AMIDO-TOLUENE** (C_7H_9N2) is a crystalline base obtained from nitrotoluene by reducing agents in the same way as aniline is prepared from nitrobenzine; it is largely manufactured for the same purpose, and is often obtained from the residues of the aniline manufacture. It distils over between 198° and 200° C. (388° and 392° Fahr.), and solidifies on cooling in white crystals. Toluidine boils at 205° C. (401° Fahr.) It requires fuming sulphuric acid for combination, forming tolylsulphuric acid ($C_7H_9NSO_3$); it does not combine with dilute or ordinary sulphuric acid.

TO'LYLENE or **BENZYLENE** (C_7H_6) is a hypothetic radicle which has not been isolated.

TO'LYLENE DI'AMINE ($C_7H_{10}O_2$) is a base crystallizing in needles, obtained from dinitrotoluene by reducing agents. It melts at 99° C. (210° Fahr.), and distils unchanged at 280° C. (536° Fahr.)

TO'LYLENE TRI'AMINES are closely related to some of the tar colours. The yellow base, chrysotoluidine, is tritolylene triamine ($C_{21}H_{21}N_3$). The violet base, violaniline, is triphenylene triamine ($C_{18}H_{15}N_3$). The brown base, mauvcaniline, is diphenylene-tolylene-rosaniline ($C_{19}H_{17}N_3$). These bases all form crystallizable salts with acids, which

have a bronze green reflection like those of rosaniline. The solutions afford fine mauve colours quite equal in intensity to those of rosaniline, and much employed in dyeing. These bases differ from each other and from rosaniline by CH_2.

TOM'AHAWK, an Indian hatchet. The tomahawks manufactured by the North American Indians are headed with stone; but the ordinary metal blades or heads are of European manufacture, and made expressly for Indian use. The handles are usually made by the Indians themselves, and often highly ornamented. Some tomahawks are formed with a bowl for burning tobacco in the head, and a hole through the handle to serve for a pipe. In the chase or warfare they are not only used in close combat, but are often thrown with such extraordinary skill as always to strike the object aimed at with the edge of the instrument. "To bury the tomahawk" is the Indian's figurative expression for making peace; "to dig it up" amounts to a declaration of war.

TO'MAN, the unit of value in Persia, is hopelessly irregular in value. An average weight of the gold toman is 3·76 grammes, ·916 fine = 9*s.* 5*d.* sterling within a fraction. The toman is divided into 100 shahis.

TOMA'TO (*Lycopersicum esculentum*) is a plant of the order SOLANACEÆ, cultivated for its fruit. It is a native of tropical America, probably of Peru, where it has long been cultivated, but is not now known in the wild state. Since the discovery of America the cultivation of the tomato has spread to Europe and Asia, as well as to other parts of the American continent. The tomato is an annual herb, with weak much-branched stems about 4 feet long, trailing on the ground or supporting themselves on other plants. It has irregularly pinnate leaves, which, as well as the stem, are covered with soft viscid hairs which exude a rather fetid resinous substance. The flower-stalks are extra-axillary, growing from the sides of the stem, and bearing clusters of yellow flowers. The flowers differ only from those of the genus SOLANUM (nightshade, potato, &c.) in the anthers being connected above by a thin membrane, and opening by a longitudinal slit. The fruit is fleshy, red, or yellow, and normally two or three-celled, but in cultivation the fruit is often irregular and many-celled from the union of two or more flowers. Many varieties are known in cultivation, differing in the size, shape, and colour of the fruit. One of these, the Cherry Tomato, is considered by some a distinct species, under the name *Lycopersicum cerasiforme*. It has round two-celled fruits about the size of a cherry, and has been found wild in Peru, and on the borders of Mexico and the United States. Another well-marked variety is the pear tomato, which has a pear-shaped two-celled fruit about 1½ inch long. The upright or tree tomato is a variety with a thick stem and short strong branches requiring no support.

The tomato is a wholesome fruit, which may be used in various ways as food. When green it makes an excellent pickle. The ripe fruit is eaten raw or cooked as a vegetable, or used for sauces, ketchup, preserves, &c. In the south of Europe, and especially in Italy, it is one of the commonest articles used in cookery. In this country it is also used to a considerable extent, large numbers being imported in addition to those home-grown. In Britain and other cold countries the seeds are sown and the young plants set out in hot beds.

The old English name for the tomato is love-apple, corresponding to the French *pomme d'amour*, and the Italian *pomo d'amore;* all these names refer to the belief that the fruit exerted an influence on the tender emotions.

TOMSK, a town of Russia, and the capital of the government of the same name, is situated on the Tom, a tributary of the Obi, 650 miles E.S.E. of Tobolsk. The population in winter is about 10,000, many of whom are engaged in gold-washing in the neighbourhood during the summer. The town is mostly built of wood, but has sbustantial public buildings, comprising a cathedral, legal tribunals, treasury, fur magazines, barracks, hospitals, and an orphan asylum. It is the residence of the Bishop of Tomsk and Yeneseisk, of a civil governor, and of the superintendent of the Altai mines; and in 1880 the foundation-stone of the Siberian University was laid here. Its inhabitants carry on a brisk trade with the Kalmucks and Ostiaks in cattle and furs, and the town has the repute of being the richest place in Siberia.

TON or **TUN,** a word which in all its different meanings seems related to the Greek *teino*, I stretch, as said of some vessel or receptacle, or the Latin *teneo*, I hold. A *Ton*, in British avoirdupois weight, signifies a measure or weight of 20 cwt., and as the hundredweight contains 112 lbs., the ton contains 2240 lbs. In the United States a hundredweight is computed at 100 lbs., and a ton at 2000 lbs. A ton or load of timber signifies in both countries 40 cubic feet of rough, or 50 of hewn timber. The hundredweight (*centner*) in Austria, Denmark, Germany, and Switzerland signifies 100 lbs.; in Hamburg, 112 lbs.; in Egypt, Turkey, and Northern Africa, it is called the *cantar;* in Italy, the *centinajo*. In France, the *quintal*, which formerly weighed 100 lbs., now weighs 100 kilogrammes, or about 220 lbs.

The *Tun* is a liquid measure of capacity, but no longer reckoned legal. For the sake of convenience, however, the term is still made use of, and in ale and beer contains 216, in wine 252 gallons.

TONE, in music, has various meanings. As a description of sound it is synonymous with QUALITY of sound. See also ACOUSTICS.

As a variety of Interval it is a major Second, and in the major diatonic scale it exists between the first and second, second and third, fourth and fifth, fifth and sixth, and sixth and seventh degrees of the scale. But upon closer inspection these tones are found to be unlike. The intervals between the Tonic and Second, the Fourth and Fifth, and the Sixth and Seventh bear the ratio 8 : 9, and are called major tones; but the intervals between the Second and Third and between the Fifth and Sixth bear the lesser ratio 9 : 10, and are called minor tones. In the present almost universal use of the equally tempered scale, wherein all semitones are of one length, every tone is simply equal to two semitones at any part of the scale.

As a class of musical compositions the word refers to certain ancient ecclesiastical chants of the Romish Church, called Gregorian tones, from their assumed collector, Gregory the Great. See GREGORIAN MUSIC.

TONE, THEOBALD WOLFE, an Irish revolutionist, was born at Dublin in 1764, and was educated at the university of that city. He was intended for the legal profession, but he abandoned it for politics. He threw himself with great ardour into the contest between the Irish people and the British government, and assisted in organizing the society of United Irishmen. He was obliged to flee the country, and took refuge first in America, and afterwards in France, where, in 1790, he concerted with General Hoche the expedition to Bantry Bay, which was dispersed by a storm, and compelled to return to Brest without having effected a landing. A second and equally futile attempt was made in 1798. The vessel in which Wolfe Tone had embarked was captured by a British frigate. He was brought prisoner to Dublin, tried by a court-martial, and condemned to be hanged, but he anticipated the sentence by committing suicide.

TONGUE. The human tongue has a very complex structure, in correspondence with the variety of its offices as an organ both of sensation and of voluntary motion. The sensations perceived by means of the tongue are of two kinds, namely, taste and touch; its motions are chiefly subservient to speech and to the prehension and swallow-

ing of food. The sensitive apparatus of the tongue is contained in the membrane which covers it; its motor apparatus forms its interior.

The surface is covered by a membrane continuous at the sides and lower part with that which lines the mouth and cheeks, and covered by a fine cuticle kept constantly moist by the saliva and by the secretion from the tongue itself. The membrane on the inferior surface is thin, smooth, and transparent; at the middle line it forms a vertical fold, which extends nearly to the tip of the tongue, and is named the *frenum linguæ*. The membrane on the sides and upper part is thicker and more vascular, and bears the papillæ, the most sensitive parts, which are thickly set over its whole surface, and are of different forms and sizes. They are very vascular, and receive filaments of the sensitive nerves. Their structure is similar to that of the sensitive papillæ of the SKIN, except that the cuticle covering them is much thinner; and their chief office is also similar, but it is probable that each kind of papillæ is subservient to a different kind of sensation.

The interior of the tongue is composed entirely of muscles, and of the fat and cellular tissue which lie between their fibres. But besides these muscles, and variously intermingled with their fibres, the tongue contains numerous other irregular fasciculi. It is also variously influenced by the muscles which move the soft palate and its arches and the hyoid bone. From the variously-combined actions of them all, the tongue is made capable of more rapid, more varied, and (for its size) more extensive motions than any other organ in the body.

The tongue is supplied with three different pairs of nerves:—1. The hypoglossal, or ninth pair of nerves, are distributed almost exclusively in the muscles: they are its motor nerves; and when they are paralyzed or divided the tongue is rendered immovable, but its sensations are unimpaired. 2. The lingual (or, as they are sometimes called, the gustatory) branches of the fifth pair of nerves are those on which the sensibility of the organ to all common impressions of touch, heat, cold, &c., depends. They are distributed most abundantly in the papillæ at and near the tip, and they endow it with a sensibility more acute than that possessed by any part of the skin. 3. The gustatory, glosso-pharyngeal, or eighth pair of nerves, of which a considerable part is distributed in the tongue, are probably those on which the peculiar sense of taste depends.

The quality by which substances are capable of exciting the sensation of taste is altogether unknown, nor has even a probable hypothesis been formed on this subject.

TONIC, the name usually given to the keynote of a scale or key in music.

TONIC SOL-FA METHOD, a system of musical notation, somewhat similar to that suggested by Jean Jacques Rousseau, and developed in the CHEVÉ SYSTEM used on the Continent (see that article), but in many of its details purely original, was invented about 1812 by Miss Glover, a clergyman's daughter, of Norwich, and adopted, modified, and popularized by the Rev. John Curwen from about 1840 onwards. The seven notes of the diatonic scale are represented by a modification of the Solfeggio syllables, *Doh*, *Ray*, *Me*, *Fah*, *Soh*, *Lah*, *Te*; Doh signifying the key-note in any and every key. In the early exercises the student is taught the value or distance of tone between one note and another by what is termed a modulator, which represents pictorially the exact distances of each note from the one immediately preceding it; the semitones are also shown occupying half the space of the full tones. In written music only the initials of these words are used; the higher and lower octaves being distinguished by the use of $(_1)$ above or below respectively: as $\mathbf{m}^1$, $\mathbf{m}_1$, &c. The name of the key is prefixed to a tune as its signature, as key F, key C, key B flat; and to indicate rhythm, a perpendicular line (|) precedes the stronger or louder accent, a colon (:) the softer accent, and a short perpendicular line (׀) the medium accent. In modulating into a new key, the note from which the transition is taken is shown by a combination of the name which it has in the old key with that which it has in the new—*me lah*, for example, being conjoined into *m'lah;* and in writing this note, the initial letter of its syllable, as a member of the old key, is placed in small size before and above the initial of the syllable of the new, as $^{m}\mathbf{l}$, $^{d}\mathbf{s}$. In the case, however, of an accidental, where the transition is but momentary, a sharpened note changes its syllabic vowel into *e*, and a flattened note into *aw*, spelled *a*, as *fah*, *fe; soh*, *se; te*, *ta*. In the minor mode, *lah* is the keynote; the sharp sixth is called *bah*, and the sharp seventh *se*. The signature of the key of A minor is "key C, minor mode." For further details the reader is referred to any of the standard works on the subject. Those who advocate this notation maintain that it possesses certain advantages over the regular notation, apart from its easiness and clearness. The cheapness of the music published in letter notation is also a recommendation. The system is open to the objection that it can never be applied on any large scale to instrumental music, and does not furnish the student with the key to the musical literature of the world. On the other hand it is very simple, and has undoubtedly served a useful purpose in allowing many to attain the art of reading music to a certain extent who would probably have been unable to master the details of the regular notation. The movement for its introduction has been marvellously well organized, and is now centred at the Tonic Sol-fa College, Forest Gate, near London. The organ of the movement is the *Tonic Sol-fa Reporter*, which has a large circulation. In the state-aided schools the tonic sol-fa notation is recognized equally with the regular notation, to the great advantage of poor children.

TON'KA BEAN or **TON'QUIN BEAN**, the seed of the *Dipteryx odorata*, a large tree of the order LEGUMINOSÆ, sub-order Papilionaceæ, a native of Guiana, having pinnated leaves and axillary racemes of purple-coloured flowers. The genus is remarkable among leguminous plants for having a single-seeded fruit which does not open at maturity, but is drupaceous. The seed or tonka bean resembles an almond in shape, but is longer and is covered with a shining black skin. It is much used as a perfume for flavouring snuff; its odour, resembling that of new hay, being due to COUMARIN. If kept among clothes and linen it preserves them from the ravages of insects. It is also used by perfumers in the preparation of sachet powders, &c.

TONNAGE and **POUNDAGE**, two ancient taxes with which the student of English constitutional history is perpetually finding himself engaged. They were in fact the old customs duties on wine and merchandise. In 1303 the English merchants compounded for the tax called *prisage* (one cask of wine in every ten) at 2*s.* a *tun* (or ton) of wine, and the tax was renamed *tonnage* ever after. Then in 1347 a tax of 6*d.* per pound was added for merchandise, except merchandise of the "staple" (wool, leather, &c.) In 1373 the joint tax of tonnage and poundage was regularly granted by Parliament, and thenceforward was regulated and granted afresh at the beginning of every reign for the whole term of the new king's life. But as a result of the arbitrary views of Charles I., the Commons, in his first Parliament, which profoundly mistrusted him, refused to grant tonnage and poundage to him for more than one year; and the Lords, displeased at the limitation, threw out the bill altogether. Charles went on to levy these customs by his own authority, and in 1629 the definite constitutional question was formally raised by the Commons, and Sir John Eliot moved a Remonstrance against the king's illegal action. The Speaker had "a command from the king to adjourn, and to put no question." Whereupon

he was held in his chair while the Remonstrance was passed by acclamation. The Parliament was dissolved, and many members were sent to prison. Eliot indeed died in prison. The king continued to levy these taxes and added others to them, and among many causes of the Civil War this of illegal taxation was the chief.

TONNAGE OF SHIPPING. There is probably no technical expression which occurs more frequently in general literature than the word tonnage. It is sometimes used to express a charge in the nature of freight, but in its more ordinary meaning, tonnage is the measure which expresses either the size, the capacity, or the carrying power of a ship. If a solid body be immersed in a fluid, it will displace a bulk of the latter equal to its own bulk. Such bulk is entirely irrespective of the weight of the solid body which we assume to be immersed. A cube of solid iron 10 feet square on each side would displace the same bulk, and therefore the same weight of water, as a wooden box of like dimensions. As the weights of equal bulks of water are approximately equal, we have thus a measure of buoyancy. A given weight, whether of wood, of iron, of cargo, or of anything that it is desired to make float, will require for its flotation the displacement of an equal weight of water. Thus the actual displacement of water (however we manage to calculate it) is always equal to the total weight or gross tonnage of a vessel with all that it contains; and if we divide the number of cubic feet of water the ship displaces by 35, the result gives a fairly approximate statement (in tons) of the gross weight of the vessel and cargo.

It is, of course, necessary for the purposes of safety as well as of convenience, to build ships of such form that the displacement of water caused by their submergence would involve the raising of a weight of water far greater than the utmost possible weight of the vessel. Further, there is a considerable margin between the displacement due to the ship and cargo when the former is fully loaded. The weight at which the vessel will swim above the water when empty or in ballast is denoted by what is called the light line. The mark of the height at which the same ship will swim when loaded is called the load line. The weight of water displaced by the vessel when sunk to the load line is called the gross tonnage. The difference of displacement between the flotation of the ship at the light line and that at the load line is the net tonnage. The registered tonnage is the official record of what the net tonnage of a vessel is calculated to be, according to the provisions of the Merchant Shipping Acts.

TON'QUIN, formerly the northern division of the Empire of Annam, now subject to a French protectorate, is a district embracing the wide alluvial basin of the Song-ka River. It is mountainous in the north, and inhabited there by hill tribes called Khas, who are considered to be aborigines, as they are lighter in colour and bigger in build than the people of the plains. The Song-ka fertilizes large rice-fields, and the coast fisheries are very productive. The climate is extreme both for heat and cold, and fearful typhoons occasionally bring great destruction to the fishing population. Hanoi or Kesho, about 100 miles from the mouth of the Song-ka, is the chief town.

TONSILLI'TIS. See QUINSY.

TON'SILS. The tonsils are two complex glands on either side of the fauces, between the arches of the soft palate. They are of an elongated oval form, and each is composed of a number of smaller glands aggregated together in one mass, and usually opening by several orifices on the surface of the mucous membrane.

They are very subject to inflammation. In its acute form this disease constitutes the most frequent kind of sore-throat. [See QUINSY.] Either after acute inflammation, or independently of it, the tonsils are also very subject to a chronic enlargement, which gives rise to a permanent difficulty of swallowing, with a peculiar nasal tone of voice, and often considerable dyspnœa. A simple and almost painless surgical operation suffices to relieve the sufferer. The use of the tonsils is to provide a viscid secretion which aids in the swallowing of the masticated food, rolled by the tongue into a bolus.

TON'SURE (from the Latin *tondere*, to shave) is the name given to a distinguishing mark of the clergy of the Roman Catholic Church, formed by shaving the hair from a circular space on the top of the head. Shaving or cutting off the hair is a universal sign among primitive races of submission to a person, and then passed into an act of worship (see H. Spencer, "Ceremonial Government"). Among the Greeks, when a boy arrived at puberty, his hair was cut off and dedicated to some deity, as among the Romans the first time of shaving. The Egyptian priests shaved their heads, and kept them continually bald, and it was probably from Egypt that the first Christian monks, by whom the tonsure was introduced into the church, derived the practice. In the sixth century the clergy began to imitate the monks in this respect, and the tonsure became a mark of pre-eminence distinguishing them from the laity. There were, however, two forms: the tonsure of St. Peter, which was a crown of hair left by shaving the top of the head and back of the neck, and which was in vogue in Italy, Spain, and Gaul, and the Old English Church; and the tonsure of St. James, made by shaving all the head in front of a line passing from ear to ear. This was the form in the early Scottish Church.

TONTINE', a species of life annuity, so called from Lorenzo Tonti, a Neapolitan, with whom the scheme originated, and who introduced it into France in 1653. The subscribers were divided into ten classes, according to their ages, or were allowed to appoint nominees, who were so divided, and a proportionate annuity being assigned to each class, those who lived longest had the benefit of their survivorship, by the whole annuity being divided among the diminished number. In 1689 a second tontine was opened in France under the directions of Louis XIV., who was then very much in want of money. The last survivor was a widow, who, at the period of her death, at the age of ninety-six, enjoyed an income of 73,500 livres for her original subscription of 300 livres. Tontines have seldom been resorted to in England as a measure of finance. The last for which the government opened a subscription was in 1789, the terms of which may be seen in Hamilton's "History of Public Revenue," p. 210. A few private speculations have been entered into in the United Kingdom on the plan of the tontine, and the principle is adopted by some life assurance companies in their payment of annuities and distribution of bonus.

TOOKE, JOHN HORNE, an English politician, was the son of John Horne, a poulterer in Newport Street, Westminster, where he was born 25th June, 1736. He was educated at Westminster School and at Eton. In 1755 he went to St. John's College, Cambridge. After leaving Cambridge he officiated for a short time as usher in a school at Blackheath, and in 1760 took deacon's orders, and obtained a curacy in Kent. He entered the church in compliance with his father's wishes, after having become a student of the Inner Temple. In 1760 he received priest's orders; and in the course of the same year was inducted to the chapelry of New Brentford, which his father had purchased for him. He, however, embraced the opportunity of leaving New Brentford for more than a year upon two different occasions, in order to travel on the Continent as tutor.

On his second return from the Continent in 1767, Horne took an active part in the political contests of the day. His opposition to the ministry was unceasing, and he became one of the most popular men of the time. He was the founder of the Society for Supporting the Bill of

Rights, in 1769, in which he was closely associated with Wilkes; but in the following year a quarrel took place between them, in consequence of which Horne lost much of his popularity. His quarrel with Wilkes drew upon him an attack from Junius, whom he answered with great success.

In 1773 he resigned his living with the view of studying for the bar. While prosecuting his legal studies he afforded assistance to Mr. William Tooke, an old friend, in resisting an inclosure bill, which would have deteriorated the value of some property belonging to Tooke at Purley, in Surrey. In return for his services Mr. Tooke made him his heir; and Mr. Horne thence assumed the name of Tooke.

On the breaking out of the American War, Tooke opened a subscription for the widows and orphans of the Americans "murdered," as he said, "by the king's troops at Lexington and Concord." The ministry prosecuted him for a libel in 1777; he was found guilty, condemned to pay a fine of £200, and to be imprisoned for twelve months. While in prison he published a letter to Mr. Dunning. Shortly after his release he applied, in 1779, to be called to the bar, but was rejected by the benchers on the ground of his being a clergyman. He had, however, previously published, in conjunction with Dr. Price, a pamphlet against the American War, entitled "Facts," addressed to the landholders, stockholders, &c., of Great Britain. After a short absence from London, he returned and took an active part in advocating the cause of parliamentary reform, which Pitt then espoused. He continued to support Pitt's party for some years, and when Fox came into power he published his celebrated "Two Pairs of Portraits" (1788). Two years previously to this he issued the first volume of his "Epea Pteroenta," or the "Diversions of Purley," the object of which was to prove that all parts of speech could be resolved into nouns and verbs, and that all words were at first applied to sensible objects.

In 1790 he became a candidate to represent the city of Westminster in Parliament, but was not returned. In 1794 he was arrested on a charge of high treason, mainly on account of his connection with the Constitutional Society. Nothing, however, of a treasonable nature could be proved against him, and he was acquitted after a trial of six days' duration, during which he distinguished himself by his calmness, intrepidity, and presence of mind. His domestic affairs having become embarrassed his friends came forward to his assistance and settled on him a pension of £600 a year. In 1796 he again offered himself as a candidate for Westminster, and was again unsuccessful. It was only by being returned in 1801 for the borough of Old Sarum by Lord Camelford, that he succeeded in obtaining a seat in Parliament. He retained it till the dissolution in the following year, but was disqualified from sitting again in consequence of an Act passed while he was in the House rendering all persons in priest's orders ineligible as members.

Mr. Tooke now retired into private life, and passed the remainder of his days at Wimbledon. He had published a second edition of the "Diversions of Purley" in 1798, and this was followed by the second volume in 1805. He died 18th March, 1812.

The best estimate of Horne Tooke is contained in a lively article on him in No. 19 of the *Quarterly Review*, understood to be from the pen of Lord Dudley and Ward. There he is described at once as "one of the best bred gentlemen of the age, as kind, friendly, and hospitable," and yet as "the Ishmael of literature and politics—his hand against every man, and every man's hand against him"—a fact which the charitable critic is inclined to ascribe to his adoption of the clerical profession against his will, and his exclusion from the legal profession, for which he was fitted, and in which he was desirous of figuring.

TOOM'ERIE, the nose-flute of the Deccan, practically the same as the POONGYE.

TOON WOOD. See CEDRELEÆ.

TOON'TOONEE, a wooden musical instrument of India, peculiar to the Hindus of the Deccan, where it is the chosen accompaniment of street singers. It is of the great lute family, but of the simplest and rudest kind. A bucket-shaped body of wood has a skin bottom. A stick or tube bound to the cylinder by the cord, which also serves to hang it in front of the performer, serves as the neck of the instrument. At the top of the neck is a tuning peg, and one solitary metal string passes from this right through the cylinder and out by a small hole in the skin bottom, being prevented from returning when strained by a leather disc. It is manifest that only one sound is possible at a time, though by fresh tuning this sound may be altered. The instrument is therefore monotonous in every sense of the word. The singer keeps striking his wretched string with a plectrum very rapidly, so as to maintain an almost continuous drone or burr. The sound is unexpectedly rich and sonorous, and possibly an instrument on this principle, but carried out in a more complete manner, might have musical value.

TOO'REE. See TARAI.

TOOTH. See TEETH.

TOOTH-SHELL (Dentalium) is the chief genus of the SCAPHOPODA, a class of Mollusca. The shell is a long curved tube, open at each end and tapering. The animal is attached to the shell near the smaller end, and has a rudimentary head, destitute of eyes or tentacles, and a long club-shaped foot. About thirty species are known, found in nearly all seas, burying themselves in the sand or mud, and feeding on Foraminifera and minute bivalve molluscs. The shells are used both for ornament and as money by some of the North American Indians.

TOOTH'WORT (Lathræa) is a genus of plants belonging to the order OROBANCHACEÆ, distinguished from the genus Orobanche by its four-cleft calyx and two-lipped corolla, the upper lip of the latter being concave, deciduous, and entire. The only species is *Lathræa squamata*, found in Britain in woods and thickets. The toothwort is parasitic upon the roots of various trees. It has a fleshy, branched root-stalk, clothed with numerous fleshy scales, resembling human front teeth, whence the name. The stem is from 3 to 8 inches high, covered with numerous fleshy, scale-like, ovate, or lanceolate bracts. The flowers are dull purple or flesh-coloured, drooping, growing in two rows on the same side of the stem. According to the mediæval doctrine of signatures, the roots with their tooth-like scales were a remedy in toothache.

TOP, a familiar toy of very great antiquity. The oldest form is the whipping-top, which is met with in both Greek and Roman classics. A fine simile in the seventh book of the Æneid is drawn from a crowd of boys eager round a whipping-top; and a proverb of Cato's was current in Rome, "Play with tops, not dice." Up till the Puritan reaction against merriment, which ruined all our old sports and still makes its miserable effects felt among us, a monster whipping-top was kept in every village for the parishioners to amuse themselves with in wintry weather. This is the "town top" which we occasionally encounter in mediæval literature.

TO'PAZ, a precious stone, so called from the island of Topazion, whence gems of similar appearance were obtained by the ancients. The stone now known under this name is a silicate of alumina in which a certain proportion of the oxygen is replaced by fluorine; but it is generally supposed that the original crystals referred to by the classical writers were really varieties of OLIVENITE. The mineral usually occurs in granitic and gneissic rocks, associated with tourmaline and beryl, and takes the form of crystalline prisms, almost always transparent, and intermediate in hardness

between quartz and corundum. The largest supplies are obtained from Brazil, but fine specimens are also frequently met with in Germany, the Ural Mountains, India, Ceylon, Kamtchatka, Siberia, the United States, Australia, and Tasmania; and some few crystals have been met with at St. Michael's Mount, Cornwall, near Cairngorm, Scotland, and in the Mourne Mountains, Ireland. There are three chief varieties of topaz—the colourless, the yellow, and the blue, the latter being mostly discovered in Brazil, and often termed the *Brazilian Sapphire*. The tint of the yellow variety can be deepened by careful heating, and even changed to pink or red, but the stones are often cracked in the process. A yellowish kind of quartz bears the name of *False Topaz*, but belongs of course to a distinct mineral species.

TOPAZ'OLITE, a yellow GARNET found in Piedmont, Italy.

TOPE (*Galeus canis*) is a small species of SHARK (Selachoidei) belonging to the family Carchariidæ. The tope is found on the British coasts, and is distributed through nearly all temperate and tropical seas, ranging to California and Tasmania. On some parts of the English coast it is known as the "penny dog," and on other parts as the "miller's dog." It is not so plentiful in the north as in the south of Britain, but it has been met with not unfrequently in the Friths of Clyde and Forth, and on the coast of Berwickshire. In length the tope is from 3 to 6 feet. Its colour is of a uniform deep slate-gray above and a yellowish-white beneath. The body is elongated, spindle-shaped; the head is moderately large, depressed, behind the eyes broad, but narrowing in front; the snout is produced, indistinctly triangular, and much flattened; the teeth are small, sharp-pointed, triangular, serrated on the outer edge; the gill-openings are five, placed in front of the pectoral fin; the caudal fin has a single notch on its lower margin, and there is no pit at its root. The young reach sexual maturity at the end of the second year. The tope lives on the sea bottom, and is very troublesome to fishermen by lifting off the bait or the hooks themselves, and frequently twisting the whole length of the line round its body if it happens to be hooked itself. In France and Italy the flesh is used as food, but in this country the only part made use of is the liver, which is melted for its oil.

TOPE, a small dome on a circular base, characteristic of ancient Indian architecture, and used to mark a sacred spot or a famous event; also to cover relics of Buddha or of a Buddhist saint. The latter kind of tope is more usually called *daghoba*. The apparent dome is not a true one, for it is almost solid within, the dome-like effect being gained by courses of masonry overlapping each other as they rise, and the exterior then being rounded off.

TOPH. See TIMBREL.

TOP'HAM, FRANCIS W., a water-colour artist of great merit, whose Italian and Spanish figure subjects are much esteemed, as well as his work from models nearer home, especially Scottish and Irish peasantry, was born in 1808, and died in 1877.

TO'PHET or **TOPHETH**, originally the name of a portion of the valley of Hinnom, which lies towards the east or south-east of Jerusalem. During a long period of Jewish history the place was sacred to Baal and Moloch, or possibly to one deity recognized by both names, who was worshipped at times by the offering of human sacrifices, especially those of children. At a later period, when idolatry had become hateful, the valley was defiled and made the receptacle of all the filth of Jerusalem, animal refuse being left to putrefy and the drier rubbish being consumed by large fires, which were tended by criminals and kept constantly burning. Under its original name of Hinnom, Græcized into Gehenna, it is used in the New Testament as a type of hell (Mark ix. 44–48), and it is in this sense that the name Tophet is generally used in literature.

TOP-KNOT (*Rhombus punctatus*) is a species of FLAT-FISH (Pleuronectidæ) belonging to the same genus as the TURBOT. It occurs in the English Channel, extending to the coasts of Northern Europe. In form it is roundish oval; the eye side of the body is rough; the edges of the scales are toothed; the jaws are equal; the first dorsal ray is not longer than the succeeding ones; the ventral and anal fins are united. The top-knot is about 6 inches in length. In colour it is brown or reddish-brown, mottled or spotted with black above. This species lives on rocky ground, and feeds on star-fish and molluscs. It is sometimes taken in nets set for surmullet. The name top-knot has also been given to another species, known as Bloch's Top-knot (*Phrynorhombus unimaculatus*) to distinguish it from Müller's Top-knot, the species above noticed. This species is common in the Mediterranean, and occurs occasionally on the south coast of England. It is distinguished from the genus Rhombus by the absence of teeth on the vomer. It differs from the preceding species by having the scales more spiny, the ventral fins separated from the anal, the eyes more prominent and closer together, and the first ray of the dorsal fin produced into a long filament. The colour is brownish-gray with black spots. The flesh of both species is delicate, but owing to their small size is not often used for food.

TOP'LADY, AUGUSTUS MONTAGUE, an English clergyman, born in Farnham, Surrey, 4th November, 1740; died in London, 11th August, 1778. He was educated at Westminster School and Trinity College, Dublin, took orders, and obtained the living of Broad Hembury in Devonshire. In 1775 he removed to London and preached in a chapel in Leicester Square. He was a controversial writer, but his fame rests principally upon his authorship of the well-known hymn "Rock of Ages." He was the great champion of Calvinism in the Church of England.

TOPOG'RAPHY (Gr. *topographia*, which is from *topos*, a place, and *graphein*, to describe). The word topography is limited by usage to the description of cities, towns, villages, castles, churches, and other artificial structures, including notices of everything belonging to the places or connected with them; for instance, not only the site, construction of the streets, public buildings, &c., of cities and towns, but the number of inhabitants, trade, history, and so forth. The word occurs in the Greek writers. Cicero uses *topothesy* (Gr. *topothesia*) as synonymous with topography, though topothesy should have a different meaning. In the Greek topography has a wider meaning than it has with us. Topography enters more minutely into local details than does geography.

TORBAY', a beautiful semicircular bay, on the south-east coast of Devonshire, in England, having on the south the Cape of Berry Head, and Hope's Nose on the north, with a breadth of 4 miles across the entrance. Here William III. landed 5th November, 1688.

TOR'MENTIL. See POTENTILLA.

TORNA'DO, a whirlwind or violent storm of wind, usually accompanied by thunder, lightning, and torrents of rain. It frequently occurs in the West Indies, on the western coast of Africa, and in the Indian Ocean. See CYCLONE.

TOR'NEA, a small town in Finland, on a peninsula at the mouth of the river Tornea, where it falls into the Gulf of Bothnia. It was built by the Swedes in 1602; consists of two principal streets of wooden houses; and has a considerable trade in the exportation of stock-fish, reindeer, skins, furs, iron, wood, tar, butter, and salmon. In summer the sun is visible at midnight above the horizon. This town, along with the grand-duchy of Finland, was ceded to Russia by Sweden, at the peace of Fredericks-hamm in 1809.

TOR'O, the capital of the province of Zamora, in Spain, is an episcopal town, situated on the right bank

of the Douro, on a gentle eminence which commands a view of an extensive plain, called Tierra de Campos. The collegiate church, a handsome Gothic building; the remains of the Alcazar or castle built by the Infante Don Garcia; the bridge over the Douro, built of freestone and resting on twenty-two arches—are the most remarkable structures. The town generally presents a decayed appearance, and many of the religious edifices have been allowed to fall into a very dilapidated condition. It contains some brandy distilleries and brick and tile works. Near Toro a battle was fought, in 1476, when the Portuguese under Alfonso V. were defeated by the Castilians under Ferdinand the Catholic. The population is about 8000.

TORON'TO, formerly *York*, the capital city of Canada West, is situated on the north shore of Lake Ontario, about 40 miles from the west-end of Burlington Bay, 165 miles from Kingston, 390 from Montreal, 560 from Quebec, and 75 from Niagara. The town was founded in 1794 by Governor Simcoe. The French had previously a small palisadoed fort a little to the west, which was called Fort Tarento or Torento. With the exception of this fort and two or three wigwams, the dwellings of a few Indians, the site of Toronto, when surveyed by direction of Governor Simcoe, in 1793, was uninhabited, and the country was almost entirely covered with forest to the water's edge. The district, as it was gradually cleared by the British, was called Toronto, after Fort Tarento; but the name given by Governor Simcoe to the town, which he laid out on a regular plan, was York, which name it retained till 1834, when Sir John Colborne raised it to the rank of a city, and changed the name to that of the district, Toronto. The town was burnt by the Americans in 1813, and suffered severely from a fire in 1849.

The situation is low and swampy, the ground rising gradually into the back country. The site seems to have been chosen chiefly on account of the spacious and beautiful harbour, or rather bay, which is about 5 miles long and a mile in width, and is protected and nearly inclosed by a long horn of sand, called Gibraltar Point. This sweeps round in a sickle shape, and leaves only a narrow entrance, forming the mouth of the harbour, which is capable of accommodating the largest vessels navigating the lakes. The entrance is protected by a strong fort, and there are two lighthouses.

The city consists of several wide streets, about 2 miles long, and parallel to the shore of the lake, which are crossed at right angles by others that run inland about 1½ mile. The pavements are formed of planks 3 inches thick, which are usually very clean. The university, cathedral, government buildings, city-hall, and market-house; Osgood Hall, of the Grecian Ionic order, containing the law courts and an excellent law library; exchange, banks, churches and chapels, and many private buildings, are handsome, and indicate the flourishing condition of the city, besides giving it a thoroughly English appearance. The university, attached to which is an observatory, is situated in the midst of the well-wooded Queen's Park, to the west of the town. The colleges of Toronto form its most striking features. Besides Trinity, which is somewhat on the lines of its namesake at Dublin, there is the great unsectarian establishment called after the city itself, and a large Presbyterian one, with several other halls and institutes. There are also a large number of excellent schools, together with various benevolent institutions, hospitals, asylums, house of industry, &c. The city generally is built of light-coloured brick of a soft pleasing tint. The avenues leading to the university are wide and spacious, and being planted with trees, form a fine shaded promenade.

Toronto has risen rapidly into importance. In 1834 its population was 9220; in 1848 it was 23,503; and in 1881 it had increased to 86,415. Among the industrial establishments may be mentioned iron and other foundries, distilleries, breweries, candle, glue, starch, soap, oil-cloth, and paper manufactories, saw and flour mills, rope-walks, &c.

As before stated, the harbour of Toronto is capacious and well-protected, admitting the largest lake vessels, and affording great facilities for extensive traffic. Lines of steamers run regularly during the summer to all the ports on the river St. Lawrence as well as to those on the lake, and the town has also excellent railway accommodation by means of the Grand Trunk, the Great Western, and the Northern lines. The exports consist chiefly of wood, flour, wheat, and other grain; the imports of cotton, woollen, and silk manufactures, hardware, and other goods, tea, coffee, tobacco, sugar, and spirits.

Since 1839 Toronto has been the seat of a bishop. When the Act of Parliament (3 & 4 Vict. c. 35), which united Upper and Lower Canada into one province, was carried into effect, on the 23rd of July, 1841, Kingston, at the north-east extremity of Lake Ontario, became the capital of Canada West. In 1849, however, the seat of the general Canadian government was transferred from Montreal to Toronto, and it continued the capital until 1860, when Ottawa, although a much smaller place, was selected by the crown as the future legislative capital of the colony, on account of its central position. The rapid progress of Toronto is unequalled in British America, and only surpassed by some of the western cities of the United States. With a more southern latitude than any other large Canadian town, and remote from the keen winds of the ocean, it has more to invite a residence, all things considered, perhaps, than any other Canadian city, though it lacks the picturesqueness of Quebec and Montreal. Many persons give it the preference, as a residence, over all its sister provincial cities. The mean temperature of the year is 44° 4′; in winter, 26° 4′; and in summer, 63° 8′ Fahr.

TORPE'DO or **ELECTRIC RAY** (*Torpedinidæ*), a family of cartilaginous fishes belonging to the suborder Batoidei (RAYS), remarkable for the possession of an electrical apparatus. The electric organs are two large flat bodies lying one on each side between the head and the pectoral fins. They "consist of an assemblage of vertical hexagonal prisms, whose ends are in contact with the integuments above and below; and each prism is subdivided by delicate transverse septa, forming cells, filled with a clear, trembling, jelly-like fluid, and lined within by an epithelium of nucleated corpuscles. Between this epithelium and the transverse septa and the walls of the prism there is a layer of tissue on which the terminations of the nerves and vessels ramify. Hunter counted 470 prisms in each battery of *Torpedo marmorata*, and demonstrated the enormous supply of nervous matter which they receive. Each organ receives one branch of the trigeminal nerve, and four branches of the vagous, the former and the three anterior branches of the latter being each as thick as the spinal cord (electric lobes). It is said that a painful sensation may be produced by a discharge conveyed through the medium of a stream of water. The electric currents created in these fishes exercise all the other known powers of electricity: they render the needle magnetic, decompose chemical compounds, and emit the spark. The dorsal surface of the electric organ is positive, the ventral surface negative" (Gunther). The situation of this apparatus is indicated on the upper surface by a slight convexity on each side of the head. Over this electric battery the will of the animal exerts a direct influence.

The shocks given by the torpedo are very considerable, and are supposed to be used by the animal both as a means of defence and to disable its prey. Some writers are of opinion that its electric apparatus has further uses:—"One

well-known effect is to deprive animals killed by it of their organic irritability, and consequently to render them more readily disposed to pass into a state of decomposition, in which condition the digestive powers more speedily and effectually act upon them. If any creature more than others might seem to require such a preparation of its food, it is the cramp ray (or torpedo), the whole canal of whose intestine is not more than half as long as the stomach." The body of the electric rays is a broad smooth disc. The tail is short, with a longitudinal fold on each side, and bears two small dorsal fins. Six species of the genus Torpedo are known, from the Atlantic and Indian oceans.

The Common Torpedo (*Torpedo marmorata*) is common in the Mediterranean, and is taken occasionally in the English Channel, and on other parts of the coasts of Britain. It is generally about 3½ feet long and 2½ feet broad, and weighs about 50 lbs., but specimens weighing as much as 100 lbs. are sometimes taken. The colour is dark brown. A second Mediterranean species, *Torpedo hebetans*, is sometimes taken on our coasts. It has the ventral fin more rounded and separated from the pectoral fin. The names numb-fish, cramp-fish, and cramp-ray are given to these torpedoes by the English fishermen. When one of them is taken hold of, a creeping sensation is felt in the whole arm up to the shoulder, accompanied by violent trembling and sharp pain at the elbow. A full-grown fish can disable a man by a single shock. Five other genera of this family are known, from tropical and subtropical seas, differing from the genus Torpedo in the position and structure of their fins.

TORPE'DOES and **TORPEDO BOATS.** The use of the military mine for land service dates from a very early period after the introduction of gunpowder, but its use for subaqueous explosions was not practically tested until the latter portion of the eighteenth century. David Bushnell, a captain of engineers in the American revolutionary army, is supposed to have been the first to make a practical application of the idea to ordinary warfare, his plan being to attach a case of powder to the hull of an enemy's vessel, by means of a submarine boat, and leave it there to be exploded by clockwork. A trial of his invention was made in 1776, when a submarine boat was sent out against the British man-of-war, the *Eagle*, but the experiment proved a failure, and it is doubtful whether the man in charge of the boat ever seriously tried to accomplish his difficult and dangerous task. In 1777 Bushnell directed a drifting percussion-mine against the frigate *Cerberus*, lying off New London, and it destroyed a schooner moored alongside. Twenty years later Robert Fulton made vigorous efforts to bring the new weapon into notice under the name of "torpedo," then first applied by him, and by which it has ever since been known. Unsuccessful in France, he went to England in 1804, and in 1805 was authorized to make an attempt to destroy the French fleet at Boulogne, which proved unsuccessful. In the same year he blew up the brig *Dorothea*, assigned to him for experimental trial, in the harbour of Deal. This was accomplished by two drifting torpedoes, which, connected by a rope, fouled the hawser, and one of them, charged with 170 lbs. of powder, exploding by clockwork under her bottom, utterly destroyed her. Notwithstanding this success, the mode of attack it indicated was regarded by public opinion as diabolical, and motives of policy, resulting from the British superiority at sea, caused Fulton and his new weapon to be rejected by the British Government, and he returned to America to encounter ultimately a like repulse, although in 1807 he repeated his experiment successfully in the harbour of New York. Fulton's system included four classes of torpedoes—viz., buoyant mines held in place by anchors and provided with a mechanical device to explode them when they were struck by a vessel; line torpedoes, of the kind used in the destruction of the *Dorothea;* harpoon torpedoes, to be attached to the enemy's vessel by a harpoon shot from a gun, and then to be exploded by clockwork (fig. 1, Plate I.); and, lastly, blockship torpedoes, to be carried on spars projecting from a peculiar kind of vessel, and exploded by contact with the enemy. Just before the close of the American War of 1812 preparations were made for an extended use of torpedoes for the defence of the harbours of the United States, but the advent of peace prevented any practical test of their efficacy. Colonel Colt, the inventor of the revolver, was one of the first to apply electricity to the ignition of torpedoes, and by its means, on 13th April, 1843, he destroyed a brig in full sail on the Potomac, operating from a station in Alexandria, 5 miles distant. Subsequently an elaborate system of electrical submarine mines was prepared by Captain Hennebert, of the French engineers, but no opportunity offered for the further use of torpedoes until the war between the Allied Powers and Russia in 1855. During this war a new kind of contact mine, devised by Professor Jacobi, was planted off Cronstadt and at Sebastopol; but though explosions occurred under the frigates *Merlin* and *Firefly*, no serious damage was done, the charge of powder employed, 8 or 9 lbs., being too small. The Jacobi fuse consisted of a little bottle of sulphuric acid, bedded in a mixture of chlorate of potash and sugar, the breaking of the bottle by contact with the vessel effecting ignition.

The first instance on record of the use of electricity in connection with torpedoes, was on the occasion of the defence of Venice in 1859. In fig. 4, Plate I., we give an illustration of the way in which the torpedoes were sunk, having wire cables attached through which the firing current could be sent. As they were placed under water their position was marked on the table of a *camera obscura*, which overlooked the waters of the harbour, into which the ends of the wires were brought, so that when an enemy's vessel approached within range of a torpedo, the fact could be immediately observed and the mine fired. This use of the *camera obscura* is shown in fig. 3, Plate I. No opportunity occurred of putting it to the test.

The first occasion on which torpedoes really played an important part in warfare was in the Civil War in the United States. The Confederates, who had no fleet, had a large seaboard and many important rivers to defend, and they relied largely upon torpedoes, both as weapons of offence and defence. In October, 1862, the service was formally legalized by the Southern Congress, and a torpedo bureau was soon established at Richmond. A special corps of officers and men was raised and trained for submarine warfare, inventions multiplied, agents were sent to Europe to provide material and get the latest ideas, and hundreds of the new weapons were fabricated at the factory in Richmond and issued for their deadly work. Very soon the southern waters became so dangerous that naval operations were seriously interfered with, and in December, 1862, the *Cairo*, a northern ship of war, was the first vessel to be blown up by the new machines. During the remainder of the war seven Federal ironclads, eleven wooden war vessels, and six army transports were destroyed by torpedoes, and many others were temporarily disabled. The Confederates lost a fine ironclad, the *Albemarle*, two steamers, and a flag-of-truce boat, the last three accidentally by their own torpedoes. The stationary torpedoes employed included some fitted with the Jacobi fuse, others having a still more sensitive chemical fuse, designed by General Rains, and some worked by means of the electric current. In addition to the floating torpedoes enormous submarine mines were laid down in the channels of the rivers, by one of which, in the James River, the *Commodore Jones* was destroyed 6th May, 1864. Automatic drifting torpedoes were used for rivers where the

current would carry them down upon a hostile fleet, ships being protected against them by submerged netting. Spar torpedoes, carried on steam launches, gave occasion for some brilliant naval exploits, such as the destruction of the *Albemarle* by Lieutenant Cushing.

One form of the torpedo used by the Confederates is shown in fig. 2, Plate I. This consisted of a stout sheet-iron cylinder, pointed at both ends, about $5\frac{1}{2}$ feet in length and 1 foot in diameter. In the figure, A represents an iron rod, armed with prongs, to fasten upon the bottom of boats going up-stream and act upon B, a lever connecting with trigger to explode a cap and ignite the powder; C, canvas bag containing 70 lbs. powder; D, anchors to hold torpedo in place. The machine was anchored so as to present the prongs in such a way that boats going down stream should slide over them, but those coming up should catch them.

Some submarine boats, designed to tow torpedoes under the bottom of the enemy's vessels, were also employed by the Confederates, one of which, after drowning twenty-three men in her preliminary experiments, actually sank the Federal sloop, *Housatonic*, in February, 1864, and herself with her crew at the same time. In addition to these recognized methods of warfare, the Confederates devised and used illegitimate infernal machines to be smuggled into the enemy's ships and magazines by spies. Of these the most dangerous was the "coal torpedo," a cast-iron case made to resemble a lump of coal, and filled with gunpowder. This was thrown into the coal of a ship, and when shovelled into the furnace blew up the boilers.

In the Schleswig-Holstein War of 1864, Denmark resorted to ingenious stationary submarine mines, and one of the enemy's vessels was destroyed by them. During the Paraguayan War a fine Brazilian ironclad, the *Rio de Janeiro*, was destroyed by two fixed torpedoes fitted with sulphuric acid fuses, and another war vessel, the *Tamandare*, was disabled, although the Paraguayan engineers were crippled by want of supplies. During the Franco-German War of 1870-71, a significant proof of the fear which torpedoes may inspire was afforded by the fact that the formidable navy of France refrained from attacking a single German harbour, it being known that strong cordons of these dangerous mines had been laid down round the mouth of every inlet. In the first stages of the Russo-Turkish War of 1877–78, a Turkish monitor was blown up on the Danube by two Russian torpedo launches, which succeeded in attaching their torpedoes to its hull and exploding them by an electric wire. The success of this attack was largely owing to the carelessness of the Turks, who failed both to keep a good look-out and to arrange for case-shot and small-arm fire; and later in the war another monitor beat off four torpedo launches which attacked her, and came out of the conflict quite unharmed. During the critical period of 1878, when the British fleet lay in the Sea of Marmora, the Russians despatched some of their torpedo boats to the same neighbourhood, and the British admiral exercised the most extraordinary vigilance to guard his ships from attack. The hulls of the vessels were defended by outrigged spars and wire nettings, electric lights swept the surrounding waters, the machine guns were kept constantly loaded and manned, while all through the night the waters were patrolled by armed steam-launches mounting 9-pounder guns.

In the present stage of their development, torpedoes may be divided into two broad classes, namely, the defensive or stationary, and the locomotive or offensive. Stationary torpedoes consist of a charge of some explosive substance, now generally gun-cotton or some form of dynamite, inclosed in a strong and water-tight case, which is sunk and secured in position at a given distance below the surface of the water, and in which a detonator is either arranged in such a manner that it shall explode the torpedo when this latter is struck by a vessel passing by, or is connected by wires with an electric battery on shore, so that it may be fired by observation. As an illustration of the manner in which they may be employed, we may refer to the system of defence adopted by the American government for the harbour of New York. In a deep casemate of the forts secure from an enemy's fire are placed electrical batteries, operating apparatus, testing galvanometers, &c., under the charge of a thoroughly trained staff. Radiating from the casemate, in subterranean galleries, the torpedo cables extend to the channel, where they terminate in multiple groups of mines, so arranged as to be flanked by the guns of the work. During the day the torpedo staff are kept in constant communication, by telegraph or telephone, with the officers on the look-out; while the guns of the fort are arranged to be fired automatically by electricity during the night, should the torpedoes they cover be grappled with and moved. On the other hand, it must be observed that the art of destroying torpedoes by means of countermines is very carefully studied in the naval schools of the present day, and it is now possible to send a boat to drop countermines without a single person being on board, the whole of its movements being regulated by an electric cable.

Offensive torpedoes are of four principal types: the outrigger or spar torpedo, the towing torpedo, the self-acting locomotive torpedo, and the moving torpedo, which is steered by means of electricity.

In fig. 1, Plate II., an illustration is given of one of the earliest forms of the outrigger torpedo, and it was with a launch and weapon of this description that Lieutenant Cushing effected the destruction of the *Albemarle* during the American Civil War. In the illustration a reserve torpedo attached to its spar is shown alongside the hull of the launch, and the dotted lines show the method of using the weapon. The spar was projected forward as far as possible and plunged under water; the torpedo was detached by a pull on a rope; and as it rose by its own buoyancy it was fired at the proper moment by means of a lanyard. The spar torpedoes at present in use are made to be pushed under water against the hull of the ship attacked, when they can be exploded by contact or by means of an electric current. Some experiments with boats of this description carried out by officers of the French navy proved that they could deliver fatal blows against any ordinary hull without being themselves injured by the explosion they caused; but as they were compelled, in order to do this, to approach within 15 feet of the vessel attacked, they would be liable to be riddled by the case-shot, small-arm, or machine-gun fire of a watchful enemy. Many of the torpedo boats of earlier construction in the British navy are of the outrigger pattern, but all boats now constructed are designed for locomotive torpedoes.

Of the towing torpedoes, that invented by Captain Harvey, of the Royal Navy, is perhaps the best, and it is certainly a weapon that would prove very effective under favourable circumstances. It consists of a stout wooden casing, strengthened on the outside with iron bands, and containing a metal shell to hold the explosive charge. In plan it is a rhomboid, the ends being angled to give the torpedo when towed a divergence of about 45 degrees from the vessel towing it, and it is also fitted with cork buoys, which afford the requisite flotation and assist in keeping the necessary angle. The weapon is made in various sizes, the largest measuring 4 feet 6 inches in length by 2 feet in depth and 6 inches in width, and being capable of taking a charge of 100 lbs. of dynamite. It is emphatically a sailor's weapon, requiring high nautical skill for its use, as well as the possession of a vessel of considerable speed. In action the tow rope is paid out from a drum on board the boat attaching, the duty of the latter being to rush past

the enemy and thus bring the torpedo into contact with his hull. This is accomplished by skilfully causing the case to dive at the proper moment by the slackening of the tow rope, and then checking the latter, making the torpedo rise and explode by contact either through the agency of a chemical contact fuse or by electricity. The official trials of this torpedo showed that it could be effectually used on the high seas as well as for the defence of harbours. (See fig. 4, Plate I.)

Of the self-acting locomotive torpedoes, the Whitehead is at once the most effective and the most extensively used. The first experiments in connection with this weapon were made by Mr. Robert Whitehead, upon the suggestion of Captain Luppis, of the Austrian navy. The right to use the first effective form of this weapon was purchased by the British government in 1871, and since that date they have been adopted by most of the nations of Europe. They have been employed on a few occasions in actual warfare, but up to the present they have never effected anything. A representation of the most recent Woolwich pattern of this weapon is given in fig. 5, Plate I.

Briefly described, it may be said these torpedoes are cigar-shaped vessels, varying in length from 9 feet 6 inches to 19 feet, and from 14 to 16 inches in diameter. They are made of thin plates of pressed steel or phosphor-bronze, and are divided into three compartments. The head contains the gun-cotton which forms the charge, and the fuse for exploding it on coming into contact with a vessel. The central compartment contains the mechanism which insures its being kept at a proper distance below the surface of the water, the design of which was long kept a strict secret, and is still officially so considered. As a matter of fact, however, it has been divulged by an English officer employed in the Turkish service, the Turks, who had not purchased the secret, being made masters of it through the capture of a torpedo which was unsuccessfully launched against one of their ships during the last war. It consists essentially of a spiral spring attached to one of the partitions, and so arranged that a change in the external pressure causes the spring to act upon a rod working horizontal rudders, by which the proper depth is maintained. A balance or pendulum is also hung in this chamber, which, as the torpedo rises or descends, swings forwards or backwards, and so exactly regulates the horizontal rudders. The rear compartment contains a supply of compressed air, which works two screw propellers, one of which is in front of the other. There is also a highly ingenious arrangement for adjusting the mechanism, by means of which the torpedo is prevented from exploding until it has reached a safe distance from the vessel using it, and by which it can be made either to float or sink if not exploded at the end of its run. The nominal range of the Whitehead torpedoes is considerable, and has even been estimated as high as 1800 yards; but their effective use is probably nearer 300 yards against a ship in motion, and 400 yards against a ship at anchor, if aimed at the broadside. They are very costly weapons, each torpedo being worth about £400. The torpedoes used by the German government, which are made by Messrs. Schwartzkopff, at Berlin, are almost exact copies of the Whitehead, except that phosphor-bronze is the metal used in the place of steel. The laboratory torpedo of Woolwich is also an improved Whitehead. One of the defects of the Whitehead is its liability to be deflected from its course by the influence of waves, tides, or currents, and with a view of overcoming this defect, a Fly-Wheel Torpedo has been designed by Captain John A. Howell, of the United States navy. It has the same outward form as the Whitehead, but is smaller and simpler in its construction. The requisite depth of immersion in this torpedo is secured by means of an ingenious diving rudder, and its motive power is derived from a heavy steel fly-wheel, to which a high velocity of rotation is given by suitable machinery on board the boat before the torpedo is launched. The energy thus stored in the wheel imparts motion to the screw-propellers of the torpedo and drives it through the water; while at the same time the rapidly revolving wheel, from a well-known principle of the gyroscope, prevents any divergence from the plane of rotation.

Formerly the torpedo was launched by hand through a tube, so that from the start to the end of the run it was dependent on its store of compressed air; then compressed air was used to blow the torpedo through the tube, and steam was also utilized for the same purpose; but the latest and best method is that by which the torpedo is launched by means of a small charge of gunpowder from a torpedo gun. Fig. 6, Plate I., shows how the Whitehead torpedo may be used from the shore from what may be termed a torpedo fort. From the sea or river there would be nothing to be seen to indicate any danger, and beyond a slight ripple the torpedoes despatched by concealed observers would give no sign until they accomplished their mission.

With respect to the last type of torpedo mentioned, the Locomotive, steered by electricity, the pattern which has achieved the greatest success up to the present is that known as the Lay, from the name of the inventor. In its outward appearance it resembles a cigar-shaped boat, weighted so as to float on the surface of the water, provided with a store of compressed air to give the necessary propulsion, and steered by means of an electric cable, which it uncoils from a drum as it rushes along the surface. In the head of the torpedo is placed a heavy charge of dynamite (the Russian torpedoes of this pattern carry 150 lbs. of explosive material), and its course is marked by means of two sight-rods in the daytime, or by two small lights, visible only to the operators, at night. As these torpedoes have an effective range of over a mile, are almost invisible as they approach, and can be used aaginst a strong current or in a rough sea, they offer many advantages for coast, channel, and harbour defence.

Another weapon of the torpedo class, but one which at present stands alone, is that designed by Captain Ericssen of America, and by him fitted to his gunboat the *Destroyer*. It consists of a long projectile having a wooden body, which can be fired from a submerged gun in the bow of the boat. The head, which consists of a pointed copper cylinder, contains 300 lbs. of dynamite and a suitable fuse, and the whole is fired by means of a powder charge, like an ordinary shell. Such a weapon would be very dangerous to handle and use, and its range could hardly be greater than a few hundred feet, but could it be used it would give a deadly blow, for no ship yet constructed could survive a contact explosion of 300 lbs. of dynamite.

Another formidable weapon of war of American construction is the Pneumatic Dynamite Torpedo Gun of Lieutenant Zalinski of the United States army. The barrel of this remarkable piece of ordnance is 60 feet long, made of iron tubing lined with brass to give a smooth interior. Compressed air, as the name of the gun implies, is the projecting force employed, and the projectile consists of a cylindrical brass or steel torpedo, 8 inches in diameter, carrying a charge of 60 lbs. of dynamite. The torpedo is exploded by means of an electric fuse, the current for which is derived from a small battery carried within the torpedo. Two forms of this fuse have been designed, one causing the explosion upon impact, and the other requiring submersion to bring about this result.

Torpedo Boats.—The first boats specially designed for the use of torpedoes were light steam launches, fitted with noiseless engines, and provided with long spars, to the end of which the torpedoes were attached. Many such boats were constructed for the different navies of Europe, and they are still retained on account of their efficiency in close

waters and for night service, though nearly all the latest boats are designed for the Whitehead torpedo. The latter weapon is now carried by all the larger ships of war, the heavy ironclads being fitted with a sufficient number of torpedo tubes or guns to give them an all-round fire. In addition to this, some heavy vessels have been constructed, in which the torpedo has taken the place of the chief weapon, as in the case of the torpedo-ram the *Polyphemus*. This formidable vessel at present stands in a class by itself, but since its construction a number of lighter and less costly ones have been built, to combine the gun and torpedo, and to rely chiefly upon their great speed and handiness for protection against the fire of heavy guns. These ships are known as "torpedo cruisers," and they have proved to be very useful additions to the navy. The torpedo boats pure and simple are of two classes—viz. those capable of keeping the sea and cruising on their own account, and those which are only fit to make runs of a few hours and are small enough to be carried by the larger ships of war. In the British navy they are known as "first-class" and "second-class" torpedo boats respectively. The torpedo boats of the second class are swift steam launches, varying from 60 to 70 feet in length, with from 13 to 15 tons displacement, and they carry two Whitehead torpedoes, travelling, when at full speed, at a rate of from 16 to 18 knots per hour. At sea they may be used to attack the larger vessels of an enemy's fleet, to act as guard-boats, and to perform the various duties assigned to swift steam launches. They are also important adjuncts to our coast defences, and in the case of war with a naval power they would be required in large numbers for the defence of our harbours, channels, and navigable rivers. The sea-going or first-class torpedo boats are cigar-shaped steel vessels, from 100 to 135 feet in length, with a beam of from 12 to 15 feet, and a displacement of 60 or 70 tons. They carry four or more Whitehead torpedoes, and steam from 18 to 23 knots per hour. Some of the earliest torpedo boats were fitted with masts and sails for cruising purposes, in addition to their engines; but the desire for a high rate of speed soon caused all sailing gear to be laid aside, reliance being placed upon engine power alone. In the designing and constructing of engines capable of giving great speed, British shipbuilders have from the first taken a foremost place, and some very remarkable results have already been achieved. In fig. 3, Plate II., we give an illustration of a torpedo boat, built in England for the Italian government, which on its trial trip attained the immense speed of 28 statute miles an hour. In their internal arrangements most of these boats are of the same pattern, and the sectional plan of a first-class Yarrow torpedo boat of the British navy (given fig. 6, Plate II.) will serve as a type of the whole class. The forward part of the boat is completely covered over by a large turtle back, which adds to the seaworthiness of the craft by throwing the water that comes upon it freely away. It forms also roomy accommodation for the crew, and incloses a large portion of the torpedo apparatus. In the bow of the boat will be seen the tube or torpedo-gun, from which the torpedo may be ejected straight ahead. Aft of the torpedo compartment are the commander's and officers' cabins, next to which come the boiler and engines. In the engine-room of a first-class boat there may be as many as six engines—one for driving the boat, two for compressing the air for the torpedoes, one for working the dynamo for producing the electric light, one for forcing air into the stoke-hole, and an engine working in conjunction with a distilling apparatus for supplying fresh water. Aft of the machinery compartment is the crew space and petty officers' cabin. The hull is divided into compartments by bulkheads, and on the deck are additional torpedo-guns, which enable the commander to discharge his Whiteheads while running past an enemy as well as when attacking end on.

Most of the larger torpedo boats now constructed are designed to act as guard-boats also, and for this purpose they are mounted with machine guns for their own protection, and to enable them to act as torpedo-boat destroyers. In fig. 5, Plate II., there is given an external view of an armed torpedo boat of the Falke type, built by Messrs. Yarrow for the British government, and fitted with sufficient machine guns to enable her to send out a rain of lead in any direction. Painted a dull colour, and lying low upon the water, torpedo boats are not easily seen, while their small size and rapidity of movement make them very difficult to hit; but, on the other hand, they are necessarily slight in construction, and their sides would be readily pierced by the larger machine guns. They are subject, when steaming, to a great deal of vibration, which is apt to disorganize their compasses, while they are close and uncomfortable for their crews, and the stokers especially find their work terribly exhausting. The high pressure, too, under which they have to work, places a great strain upon the machinery, and a very small matter will suffice to disable them. In the naval manœuvres which followed the Jubilee celebration of 1887, it was found that the torpedo boats were quickly disabled, and a few weeks' cruise in smooth water sent several of them into port for repairs. Among the latest designs for torpedo boats are those in which the boat is intended to travel under water, so as to approach unperceived by the enemy, and to be protected against his fire. In Plate II. two of these submarine torpedo boats are shown. The first (fig. 2) is the Goubet Submarine Boat, so called after the name of its inventor, which has been adopted by the Russian government. In this boat the torpedo is carried outside, and is attached to an electric wire wound on a drum, by which it can be fired when left in position. The seat of the boat is a reservoir of compressed air, and at the bottom are reservoirs of water communicating with a pump, and a pump is also used to expel the vitiated air. The boat is submerged by pumping in water, and raised by pumping it out, and is propelled by means of electric accumulators and a dynamo. It is intended to place these boats in line with an enemy's vessel, then submerge them and propel them against her. On reaching her the torpedo is placed against her and the boat withdraws, paying out wire by which the torpedo can be exploded when a safe distance is reached. We are unable to say what results, if any, have been obtained in practice with these boats, but if they correspond in their construction with the published description, they must be very complicated affairs and very difficult and dangerous to manage. The Nordenfeldt Submarine Torpedo Boat, shown in fig. 4, Plate II., is a larger and simpler vessel, and will be found described under SUBMARINE NAVIGATION.

For protection against torpedo attacks the larger vessels depend chiefly upon the use of swift launches armed with machine guns, upon swift gunboats known as torpedo-catchers, upon defensive nettings hung round their hulls, upon the bullet and shell-firing machine-guns which they carry as part of their armament, and lastly, upon the electric light, by which they are enabled to search the surrounding waters at night. Many plans have also been proposed for the defence of the hull itself, one of the most promising being that of making double bottoms and sides, divided into a large number of small compartments, and having the compartments filled with canvas, cork, oakum, or what seems better than either, a mixture of powdered and stringy cocoa-nut fibre known as cellulose or cofferdam.

At the present period there are many competent observers who predict that the day of the heavily armed and armoured ship of war is over, and that in the future swiftness will be relied on rather than strength. They also consider that for defensive purposes the torpedo has greatly limited the power of attacking or blockading fleets, so that

war in future will have to be conducted in very different lines from the past. On the other hand, it must be admitted that the range of the defensive torpedo is very limited, and where gun-cotton or dynamite is employed torpedoes cannot be placed very near each other, for in such case the explosion of one would serve to fire by concussion all the rest. Offensive or mobile torpedoes, too, have never yet been tried on any large scale in practice, and there is good reason for thinking that their powers have been over-estimated. Apart from all theories, however, it must be admitted that the rapid development of the torpedo which has taken place during recent years has introduced many unknown elements into naval warfare, and in spite of all the investigations and manœuvres made during peace, the next serious naval war will be a series of terrible experiments, the result of which it is impossible to foresee.

TORQUAY', a very fashionable and favourite watering-place of England, in the county of Devon, situated on a steep shore of a cove at Torbay, on the north side. It is a station of the South Devon Railway, 18½ miles south of Exeter, and 210 from London. Torquay has all the usual appliances of a large sea-side resort, with superior schools, &c. It is a market-town, and contained 24,767 inhabitants in 1881. Having a southern aspect, sheltered on all its other sides by heights, a mild climate, and an almost perfect freedom from fogs, it is peculiarly adapted for delicate invalids, who resort to it in very large numbers. The scenery around is of the most varied and picturesque description. The original parish of Torquay has been divided, and there are now several churches, a Roman Catholic chapel, and other places of worship. An excellent harbour was completed in 1871, by Sir Lawrence Palk, at a cost of £60,000. It is of great service, not only to the shipping belonging to the port, but as a harbour of refuge. Some quarries of beautifully tinted marble are worked in the vicinity, and Torquay is the seat of the manufacture of the finest terra-cotta ware now produced. It was near to the coast of Torquay that Napoleon was brought by an English man-of-war prior to his final exile; and he is reported to have exclaimed, "What a beautiful country! How much it resembles Porto Ferrajo, in Elba!"

TORQUEMA'DA, TOMAS DE, founder of the Spanish Inquisition (born in 1420), was appointed confessor to Queen Isabella in her early years, and, it is said, extorted from her a vow that if she should ever come to the throne, she would devote herself to the extirpation of heresy. Consequently, when Queen Isabella solicited from the Pope, Sixtus IV., a bull for the introduction of the Holy Office into Spain, on the 17th of September, 1480, the Dominican monks were appointed as inquisitors; but owing to the sturdy opposition of the Castilians the institution gained no footing for some years. By two briefs (dated 2nd August and 1st October, 1483) Torquemada was invested with full powers to frame a new constitution for the holy office. The odium excited by his severities was such that Torquemada was thrice obliged to send an agent to Rome to defend himself; and at length (1494) Alexander VI., under pretext of relieving the infirmities of his great age, appointed four coadjutors to share the duties of the holy office with him. It is said that Torquemada was tormented by constant fears lest vengeance for his atrocities should overtake him. He died in 1498.

TOR'RE ANNUNZIA'TA, and **TOR'RE-DEL-GRECO,** two towns of Italy in the province of Naples, on the bay of Naples, situated at the foot of Mount Vesuvius, in the midst of fine villas and beautiful gardens. Torre Annunziata manufactures arms and powder, and macaroni. Torre-del-Greco was overwhelmed in a lava stream in 1794.

TOR'RES STRAIT was named after the Spanish navigator Luis Vaez de Torres, who was the first to pass through it in 1606. It is situated between the north-eastern part of Australia and the southern coast of Papua or New Guinea. Its average width is 80 miles, and it forms the nearest route to Australia from Singapore, India, and China. It is full of islands, shoals, rocks, and reefs of various extent, so that the navigation is beset with dangers.

TOR'RES VE'DRAS, a small town of Portugal in the province of Estremadura, 25 miles north-west of Lisbon, celebrated for the lines of defence established here in 1810, by the Duke of Wellington, to prevent the approach of the French on Lisbon.

TOR'REYA is a genus of plants belonging to the order CONIFERÆ, tribe Taxeæ, the species of which are known under the popular appellation of Stinking Yew or Stinking Cedar, on account of the unpleasant odour emitted by the leaves and wood when bruised or burnt. The species are small evergreen trees, from 20 to 50 feet high, with spreading branches, linear two-rowed leaves and diœcious flowers. They are natives of China, Japan, and North America. *Torreya taxifolia* is a native of Florida, and has been cultivated in Britain since 1840. It grows to a height of from 20 to 40 feet. The wood is dense and close-grained, but has a strong peculiar odour. It makes excellent rails, and is not liable to the attacks of insects. The tree may be propagated by grafting on the common yew. The kernels of the seeds of *Torreya nucifera* supply an oil sometimes used for culinary purposes.

TORRICEL'LI, EVANGELIS'TA, a celebrated Italian physicist, was born at Piancaldoli on the 15th of October, 1608, and died at Florence on the 25th of October, 1647. He was brought up at Faenza by his uncle, an ecclesiastic, who sent him to Rome about 1628, in order that he might study mathematics and physics under Galileo's pupil, Castelli. He there learned the true principles of the mechanics of moving bodies, discovered not long before by Galileo, and applied them to various important questions. He demonstrated the most important properties of the common centre of gravity of a system of connected bodies, and discovered the law of the flow of fluids out of orifices, which is the foundation of the whole science of hydraulics. He possessed much skill in pure mathematics, and proved it by discovering the area of the cycloid. After passing thirteen years at Rome he went, in 1641, to Florence by the invitation of Galileo, who died three months after his arrival. Torricelli was then appointed professor of mathematics at Florence, where he passed the few remaining years of his life. His greatest scientific achievement was one of the most important inventions that ever has been made—that of the barometer, in 1643. It is commemorated by the term, "Torricellian vacuum," applied to the space above the mercury.

TOR'SION means twisting; and it is used to denote the state of strain into which a bar of solid material is thrown when a pair of equal and opposite couples of forces are applied to its two ends, so as to balance each other by exerting equal tendencies to turn the bar in opposite directions.

TOR'SION BALANCE, an instrument for accurately measuring small forces by means of their effects in twisting an elastic fibre. It was first invented by Coulomb, as a means of measuring the forces of electricity and magnetism, and has been modified and improved by various other physical inquirers. See COULOMB.

TORSK (*Brosmius brosme*) is a fish belonging to the cod family (GADIDÆ). The body is moderately elongated and covered with very small scales. There is a single dorsal fin extending over the greater part of the back; the anal fin is also long, and there is a separate rounded caudal fin. The ventral fins are narrow, formed of five rays. The head is small, and has one barbel under the chin. The

torsk is usually from 18 inches to 2 feet long, but sometimes attains a length of 3 feet. The head is dusky, the back and sides yellow, and the belly white. It is found off the coasts of Northern Europe and the Atlantic coasts of North America, and extends into the Arctic circle. It is taken on the Scotch coasts, and is abundant off the Shetland and Faroe Islands. It lives on rocky bottoms in deep water, approaching the land in shoals in the spawning season, which is very early in the year. It is caught in the same way as cod, ling, &c. The flesh is firm and tough when fresh, but excellent when dried and salted.

TOR'SO, the trunk of the human figure, as apart from the limbs. Many of the antique statues exist, unhappily, only as torsi. The famous torso of Hercules in the Vatican has the reputation of having inspired Michelangelo to vie with the majesty of the antique. The term is the Italian *torso*, a stump or stalk, and comes from the Greek *thursos*, which has a like meaning.

TOR'STENSOHN. See THIRTY YEARS' WAR.

TOR'TOISE is the general name for the animals belonging to the CHELONIA, an order of REPTILES. The tortoises, looking at them collectively, are all more or less completely inclosed in an external development of the skeleton, or of certain parts of the skeleton, which form a back and breast plate (*carapace* and *plastron*), covered either by horny plates or by a coriaceous membrane. In solidity, extent, and form this panoply of defence presents numerous modifications, being the most developed and solid in the species, which are purely terrestrial in their habits, and which from the slowness of their movements need such a security.

The dorsal buckler, or carapace, is formed by a singular expansive development of eight pairs of ribs, united down the middle by a longitudinal succession of angular plates, formed by the flattened spinous processes of the dorsal vertebræ from the second to the eighth. This portion of the skeleton is therefore thrown externally so as to form a shield more or less convex, more or less extensive. But besides these portions which are connected together by sutures, there is a marginal set of bones which unite the sides of the carapace to those of the plastron. These marginal plates, of which there are eleven on each side, are *membrane bones*, that is, ossifications of the skin; there are generally a small number of single or paired plates of similar origin completing the framework of the carapace.

The abdominal buckler, or plastron, consists of nine osseous portions, of which eight are in pairs; the ninth is single, and occupies the anterior portion of the plastron between the first four pairs, sometimes being articulated only to the primary pair, sometimes to the next in succession also. These nine pieces vary exceedingly in figure according to the genera and species. The plates composing the plastron are solely membrane bones, and are not modifications of the sternum or breast-bone, as was formerly supposed. The sternum is entirely absent.

Within this case, more or less complete, are contained the viscera, and other portions of the osseous system, as the bones of the shoulder, the pelvis, &c.

As it is in tortoises of terrestrial habits that the plastron presents the greatest solidity, so it is in these animals that it presents some of the most remarkable differential characteristics. Its union to the carapace is by an extensive lateral surface; and at this line of union it is sometimes slightly movable, but is mostly fixed by an unyielding suture. Its anterior and posterior margins are generally indented or notched for the more free egress of the neck and the tail. Sometimes, however, they are simply truncate, or, on the contrary, prolonged into a point. In one genus (Pyxis) the plastron is furnished with a transverse hinge, giving mobility to the anterior portion, so that the animals can retract their head and fore-limbs within the carapace, and close the plastron upon it, so as to shut them in. There is, however, another genus (Kinyxis) in which the carapace, instead of being one solid whole, has the posterior portion distinct from the anterior, and movable, so as to close upon the hinder margin of the plastron, and shut in the hinder limbs and tail. In the marsh tortoises, which resemble the terrestrial tortoises in the general construction and union of the plastron, there are genera which have this abdominal shield also furnished with transverse hinges. In the genus Cinosternon the plastron has two movable valves, one anterior, one posterior, hinged on an intermediate fixed piece, so that the animal can shut itself completely in. In the genus Cistuda there is only one hinge dividing the plastron into two movable parts. In the genus Sternotherus the anterior part only of the plastron is movable.

In the Matamata (*Chelys matamata*) the plastron is narrow, elongated, and firmly consolidated to the costal plates of the carapace. In the *Emysaurus serpentinus* the plastron does not form a complete covering to the abdomen; it is narrow, and terminates anteriorly in a point which is enveloped in the skin, but its middle portion extends to meet on each side the edge of the carapace. In the river tortoises, as the Trionyx, the osseous part of the plastron is imperfectly developed, and is bordered all round by a tough leathery skin, which unites it to a similar skin bordering the imperfect carapace. In marine tortoises, or turtles, the plastron is united to the edges of the carapace by intervening cartilage, and not by suture. The tortoise-shell of commerce is produced chiefly by thin horny plates of the epidermis, covering the carapace of the Hawksbill Turtle (*Chelonia* or *Caretta squamata*).

The skull is remarkably solid, and its surface is continuous, without any movable articulations, as is the case with the serpents; and, moreover, the nasal bones are altogether absent, their place being taken by two prefrontals. The parietal bones are largely developed and send down a process to the basi-sphenoid.

The jaws of tortoises are not armed with teeth, but are cased in horny coverings, often resembling the sharp hooked beak of a parrot, by means of which they crop and mince the vegetable aliment on which they feed. All, however, are not herbivorous, and hence arises considerable modification. In some species, as the Trionyx, for instance, around the outside of this beak are thick fleshy lips; the food consists of small living animals, as amphibia, young birds, reptiles, &c.

The limb-girdles are simple in the Chelonia. The shoulder-girdle consists of three bones set at angles to one another, the scapula, a large coracoid, and a large acromion process. In the terrestrial tortoises the feet are stump-like, the toes being so enveloped in the skin that their independent mobility is very limited. These animals are slow and laborious in their progressive movements: they do not put the whole sole to the ground, but only the edge of the sole, furnished with horny laminæ, tubercles, or hoof-like nails, which indicate the situation of the ultimate joint of each of the toes. In the marine tortoises, or turtles, we find the limbs converted into broad flat undivided paddles or oars, admirably adapted for subaquatic progression, but awkward as instruments of locomotion, even on the low level shores to which these animals resort at the breeding season. Between the land tortoises and the turtles certain forms adapted for lakes and rivers intervene, and in these we find the feet palmated, the toes, which are elongated, being united to each other by means of an intervening web.

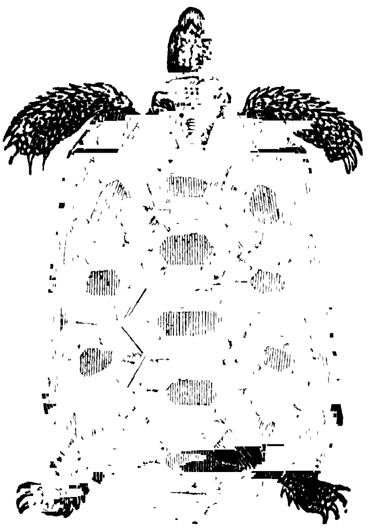
All the Chelonia respire air. The lungs are of great extent, and placed in the same cavity with the abdominal viscera. The thorax, in most of them, is immovable, and the fixed ribs can give no assistance in respiration in the full-grown normal forms. It is therefore by the play of the parts about the mouth that the tortoises respire, and here the complicated hyoid bone is called into prominent

action. The jaws are closed, and the animal alternately elevates and depresses the hyoid bone; the first movement lets the air enter by the nostrils, and the tongue then closing their interior aperture, the second movement compels the air to penetrate into the lungs. In short the tortoises swallow or gulp down the air necessary for their respiration like the frogs.

The tongue of the tortoises is fleshy, like that of the parrots, and is covered with a thick rugged membrane, often beset with pointed papillæ. The mouth opens into a capacious gullet and œsophagus, and the stomach is long, cylindrical, and bent, with very muscular walls. The intestines are generally long, shorter in the carnivorous forms.

With regard to the senses of these reptiles, we may observe that the brain is but little developed; indeed, in the marine species the mass of the brain does not entirely fill the cavity of the skull. With this condition of the brain are conjoined great muscular irritability and extreme tenacity of life. Redi proved by direct experiment that some of these reptiles live and move about for a considerable time after the brain has been removed, or even the whole head cut off. The sense of hearing, both as anatomy and observation seem to indicate, is tolerably quick in these animals; it may not be very acute, but it is sufficient to give warning of danger, or of the approach of creatures which form the prey of the carnivorous species. The eye in the Chelonia is well developed, and is large; moreover, it is modified so as to be adapted to the medium, whether of air or water, through which light is to be transmitted. In the substance of the cornea scales or osseous plates are found analogous to those of birds. There are three eyelids and two lachrymal glands. The senses of touch and taste are very limited.

The Chelonia are generally distributed over the warmer parts of the globe, inhabiting the land, the sea, rivers and marshes. None are indigenous in our island. The land species appear generally, if not altogether, to hybernate, or

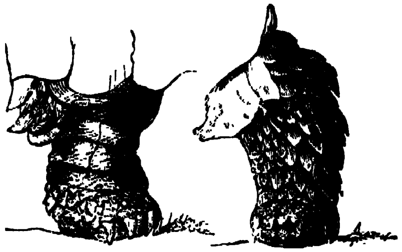


Pyxis arachnoides, seen from above.

in hot latitudes to æstivate; that is, to retire underground and there take their siesta during the dry season, until the revivifying showers reanimate dormant nature, whether animal or vegetable. All are oviparous, burying their eggs, which are hatched by the warmth of the sun. The terrestrial species are slow in their movements, but the aquatic species swim with great facility, some even with rapidity, on or below the surface of the water. The actions of the marine tortoises below the water resemble those of birds in the air—the paddles flapping, so to speak, like aquatic wings. The chelonians are remarkable for their powers of abstinence, some being able to live for months, or even years, without food.

The order Chelonia is generally divided into five families, Testudinidæ, Emydidæ, Chelydridæ, Trionycidæ, and Cheloniidæ.

The Testudinidæ are the land tortoises, to which the name tortoise is often restricted. In this family the carapace is convex, bony, and covered with horny plates; the plastron is broad, flat, and solid, soldered for the greater



Fore and Hind Leg of *Testudo actinodes*.

part of its lateral edges to the carapace, leaving only narrow openings for the limbs. The head, limbs, and tail are completely retractive within the shell. The head is generally short, thick, and quadrangular, with the eyes placed laterally, and the horny sheaths covering the jaws either solid and sharp-cutting, or more or less toothed. The legs are very short and scaly, and the feet are thick and truncated, with five claws on the front feet and four on the hind. The species are numerous and widely distributed in all the warmer parts of the world except Australia. They live on land, and feed on vegetable substances, worms, snails, and slugs.

The Common or Greek Tortoise (*Testudo græca* (fig. 1 of Plate) is a native of most of the countries bordering on the Mediterranean. It is a small species, from 6 to 10 inches in length. The carapace is oval and convex, smooth or striated concentrically, yellowish-green in colour, spotted and marbled with black. It prefers sandy and woody spots, and feeds on herbs, roots, worms, and snails. During the winter this tortoise retires into holes, which it digs in the ground to a depth of 2 or 3 feet, and remains in a state of torpidity until the spring. It is easily domesticated, and is imported into England in considerable numbers to be kept in gardens, where it makes itself useful by destroying slugs, &c. Like other tortoises it lives to a great age. In Southern Europe it is used for food.

Some very large tortoises of the genus Testudo, belonging apparently to several species, are found in the Galapagos Islands, where, however, they appear to be approaching extinction. They have long legs, very long necks, and small heads. The shell is solid but thin, and generally black in colour. These tortoises are from 3 to 4 feet in length, and weigh over 200 lbs., a much greater size and weight being said to be sometimes attained. A graphic account of these gigantic tortoises is given in Darwin's "Journal" of his voyage in the *Beagle*. These species were formerly confounded under the title *Testudo indica*, under the idea that they were natives of India. Three small species are found in that country. There are several species of the genus Testudo in America, one of the best known being the Gopher (*Testudo polyphemus*), found in Carolina, Georgia, and Florida. The genera Pyxis (see cut) and Kinyxis also belong to this family.

The families Emydidæ (figs. 2, 3 of Plate) and Chelydridæ (fig. 4) have been already noticed under TERRAPIN,

the common name for many of the species. They inhabit rivers, ponds, and marshes, feeding chiefly on animals. The TRIONYCIDÆ (fig. 5) are the mud or soft tortoises, having the carapace flat and incompletely ossified. They inhabit rivers and lakes in the tropics, and are carnivorous. The last family, Cheloniidæ, is wholly marine, containing the TURTLES (fig. 6).

TOR'TOISE BEETLE (*Cassida viridis*) is a small British beetle, belonging to the family Cassididæ (HELMET BEETLES). The tortoise beetle is light green in colour. The body is completely concealed under a thin, oval, slightly concave shield, formed by the expansion of the thorax and wing-cases, and somewhat resembling the carapace of a tortoise, whence the popular name given to this little beetle. It feeds chiefly on thistles. The larva is found on the same plants, screened from observation by a mass of its own excrement, which is attached by a horny forked process situated at the tail, and capable of being bent back over the body.

TOR'TOISE-SHELL is procured from a marine tortoise called the Hawksbill Turtle, or *Testudo imbricata.* Each animal furnishes thirteen principal plates, five along the centre of the back, and four on each side, and twenty-five smaller scales or plates, which constitute the margin of the shell. The size and thickness of the plate depend on the magnitude and age of the animal, a fresh layer being produced every year; and at the margin of the large plates may be distinctly seen the edges of the layers as they thin off in succession. The horny plates which constitute true tortoise-shell are separated from the bony foundation forming the shell or covering of the animal by the application of heat; the whole shell being commonly placed over a fire until the plates begin to start from the bone, after which the separation is completed by the aid of a slender knife. The shells vary much in value, being frequently injured by barnacles, limpets, and other shell-fish adhering to the turtles while alive, and interfering with their growth. The yellow-coloured shell is more valuable than that which is mottled.

The processes of manufacturing articles of tortoise-shell are very similar to those described under HORN; but on account of the high price of the material, it is economized as much as possible. It is extensively employed in the manufacture of combs, snuff-boxes, eye-glass frames, &c.

The qualities of tortoise-shell, as brought to market, are thus distinguished: Manilla, fine and large; Singapore, nearly as good as Manilla; West India, large and heavy, but red; Honduras, darker, but with large dark red spots; Calcutta, dark, heavy, and badly coloured; and Bombay, the worst kind. Sometimes plates are obtained as large as 13 inches by 8 inches, and a quarter of an inch thick in the middle. It thus appears that the choicest description is that imported from the Indian Archipelago.

TORTO'LA, one of the Virgin Islands, British West Indies, 10 miles by 2½. The centre is hilly and rugged. It has exports of copper ore, sugar, molasses, rum, &c. This island was discovered by Columbus, 1493, and was first settled by the Dutch, but has been British since 1666. The chief town is Road Harbour. It has an area of 25 square miles and a population of about 7000.

TORTO'NA (the ancient *Dertona*), a town of Northern Italy, is situated 14 miles E.S.E. of Alessandria, on an eminence near the river Scrivia. It gives title to a bishop, and has a cathedral, several churches and convents, and a royal college. There are some manufactures of silk, leather, hats, &c. It was one of the towns of the Lombard League, and a place of considerable strength until dismantled by the French in 1796. The population in 1882 was 14,317, who carry on an active trade in corn, wine, &c. West of Tortona lies the plain of Marengo, with the villages of Marengo and San Giuliano, where Bonaparte gained an important victory over the Austrians, in June, 1800.

TORTO'SA, a town of Spain, in Catalonia, 46 miles south-west of Tarragona, on the Ebro, here crossed by a bridge of boats. It is a bishop's see, and fortified, and has a cathedral, an episcopal palace, &c.; manufactures of leather, paper, hats, china, earthenware, soap, and brandy; oil and flour mills; a harbour, fisheries; and a considerable coasting trade, the Ebro being navigable up to the town for vessels of 100 tons burden. Population about 25,000.

TORTRI'CIDÆ is a family of SERPENTS (Ophidia) belonging to the section Angiostomata. This section, which includes only the Tortricidæ and two other small families, Uropeltidæ and Typhlopidæ, is distinguished from all other serpents by the non-dilatable character of the mouth, the squamosal bone being small or absent, and the quadrate bone being attached directly to the skull. The Tortricidæ or Rollers have a cylindrical body, a short indistinct head, and a small conical tail. They have a rudimentary pelvis, and in one genus (Cylindrophis) rudiments of hind limbs are also present in the shape of the femur and tibia, the latter terminating in small horny claws. In the genus Tortrix the premaxillary bones bear teeth—an unusual character, but found also in the Pythons. The best known species is the Coral Snake (*Tortrix scytale*), a native of Guiana. It is a small harmless snake, from 2 to 2½ feet in length. The body is vermilion red in colour, beautifully ringed throughout its length with close bands of black. It lives on the ground in boggy places, and feeds on worms, insects, and small reptiles.

TOR'TURE, in a legal sense, means the application of bodily pain in order to force discoveries from witnesses, or confessions from persons accused of crimes. Torture was applied to slaves at Athens. The Roman law allowed torture only in the case of slaves when examined either as witnesses or offenders.

In most German cities judicial torture was unknown until the end of the fourteenth century; although it appears in the statutes of the Italian municipalities at a much earlier period. Torture continued in many European states until the middle of the last century, when more enlightened views led to a general conviction of the inefficacy and injustice of this mode of ascertaining truth. In France the "question préparatoire" was discontinued in 1780 by a decree, which is in Merlin's "Répertoire," vol. x., p. 502; and torture in general was abolished throughout the French dominions at the Revolution in 1789. In Russia its abolition, though recommended by the Empress Catharine in 1763, was not effected until 1801. In Austria, Prussia, and Saxony it was suspended soon after the middle of the last century; but although so seldom used as to be practically extinct, torture was allowed by the laws of Bavaria, Hanover, and some of the smaller states of Germany, until the end of the last century. In Scotland, the use of torture prevailed until the reign of Queen Anne, when it was declared by the Act for improving the union of the two kingdoms (7 Anne, c. 21, s. 5), that in future "no person accused of any crime in Scotland shall be subject or liable to any torture."

From the year 1468 at least until the Commonwealth, the practice of torture was frequent in England; particular instances are recorded in the council-books, and the torture-warrants in many cases are still in existence. The last instance on record occurred in 1640. But although the practice continued during the two centuries immediately before the Commonwealth, it was condemned as contrary to the law of England by judges and legal writers of the highest character who lived within that period. That, however, which was not lawful in the ordinary course of justice, was done under the prerogative of the crown, which authorized this mode of discovering crimes that affected the state, such as treason or sedition, and sometimes of offences of a grave character not political—acting in this respect independently of, and even para-

mount to, the common law (Rolls of Parliament, 20 Ed. I., 1292). This view of the subject is confirmed by the circumstance that in all instances of the application of torture in England, the warrants were issued immediately by the king, or by the Privy Council. The consequence was that in no country was torture so dangerous an instrument of power as in England. In other countries, where it was part of the system of trial, it was subject to rules and restrictions, fixed and determined by the law; but in England there were no rules, no law beyond the will of the king.

TOR'ULA. See YEAST.

TORY, a well-known political watchword or party name in English history, which has, of late years, somewhat given way to the terms "Conservative" and "Constitutional." The word is said to have been derived from "Tora, Tora," the Irish equivalent for "give, give," or "stand and deliver," and was first employed in the reign of Charles II., with reference to certain bands of outlaws who professed the Roman Catholic faith and harassed the English. It was afterwards used reproachfully towards the partisans of James II., and subsequently generally assumed by those individuals who took high ground in the defence of church and state. See WHIG.

TO'TEM, the North American Indian equivalent for the Lares of the Romans. The totem is some animal (or, in rarer cases, some plant) which is believed to be the ancestor of the tribe, and which is worshipped, standing as the symbol of the tribe, or answers, as it were, to a patronymic or surname; for when a "brave" dies it is the name of his totem, and not his personal name (Red Shirt, Black Bull, &c.), which is recorded on his place of burial. The turtle, the bear, and the wolf are among the most honoured of totems. The tribe always reveres its totems. Thus the Osages, who are "beavers" by totemism, never destroy a beaver.

Totemism is rife also among the Indians of the East. The Khonds, for instance, are known as "bears," "owls," "deer," &c. The "eels" of Nagpore protect their fishy totem, and the "hawks" and "herons" are equally reverent to theirs. In Africa the natives of Guinea, the Hottentots, many of the Congo tribes, and the Bechuanas, all adopt the totem, though the latter do not worship it. In China flower-totems are more common than animal-totems. In Australia (under the name *Kobong*) totemism is rife, with all its peculiarities, except absolute worship. The religion of ancient Egypt, with its incessant animal forms, is by many learned antiquaries held to contain large elements of totemism, and the totems of many of the ancient Greek tribes are preserved to us, as for instance, one at Athens had an asparagus totem. Totems need not be distinguished by qualities that strike the imagination—force, cunning, agility, or courage—for toads, frogs, and sardines are totems in Canada, Peru, and India, while sand, water, maize, and rushes are American totems.

TOT'NESS or **TOTNES,** a market-town and municipal borough of England, in the county of Devon, is situated 29 miles S.S.W. from Exeter, and 223¾ from London by the South Devon Railway. The town stands on the slope of a hill on the west side of the river Dart. On the east side is Bridgetown, and the river is navigable for small vessels as high as the bridge which unites these two places. Large quantities of cider, corn, and agricultural produce are exported; the imports are chiefly coal and timber. Totness is very ancient, but has a neat and clean appearance. There is an old church of the fifteenth century and a modern church. There are chapels for Independents, Wesleyans, and Unitarians; a guildhall, grammar-school, gaol, and assembly-room. A granite obelisk was erected near this town in 1864 to the memory of Mr. W. J. Wills, the Australian explorer, who was a native of this place. The trade of the town arises chiefly from the extensive district which surrounds it. The municipal borough is governed by four aldermen and twelve councillors, including a mayor, and the population of the borough in 1881 was 4089. The town has a quaint appearance, and the round keep and gate of the Norman castle, built by Judael de Totenais, are still to be seen, besides the arches of two town gateways, and traces of a Roman road.

TOTTEL'S MISCELLANY is an exceedingly famous book in the history of English literature. It was printed by the bookseller Richard Tottel in 1557, the year in which the same publisher brought out Tusser's quaint "Hundreth Good Points of Husbandry." The miscellany was the first collection of its kind, and was made up of entirely original verse, by Sir Thomas Wyatt, the Earl of Surrey, Grimoald, and one or two others. The sub-title was "Songes and Sonnettes written by the Ryght Honorable Lorde Henry Haward, late Earl of Surrey, and others." There were 271 poems altogether, 30 being by Grimoald, and most of the remainder by Wyatt and Surrey. The miscellany passed through several editions, and these differed considerably from one another. It is always remembered, apart from its wonderful beauty of workmanship, as enshrining the first English sonnets and the first English blank verse.

TOU'CAN (*Rhamphastidæ*) is a family of birds belonging to the order SCANSORES. The toucans are remarkable for the great development of the bill, which is in some cases more than half the length of the body. The substance of the bill is, however, cellular, so that in spite of its unwieldy bulk it does not appear to interfere to any extent with flight. It is curved towards the tip, which is generally sharp; and the margins of both mandibles are dentated throughout their length. The tongue is very narrow, and fringed on each side with long slender appendages, like the barbs of a feather. The eye is large, and surrounded by a triangular naked space. The tarsi are short and stout, and are covered, like the long powerful toes, with shield-like plates on the anterior surface. The claws are curved and much flattened. The wings are short and rounded.

The toucans are abundant in the great forests of tropical America. They are usually seen in small flocks, hopping from branch to branch of the highest trees. They feed principally on fruits and seeds, but they are also said to attack and devour small birds and reptiles, and plunder birds' nests of their eggs. Their flight is easy and graceful. When resting they puff out their plumage, throwing up at the same time their tail over their back, while the bill lies in a horizontal position, the whole combining to give them an appearance of sedate laziness. They lay their eggs in holes of trees, the eggs being two in number, white, and roundish. They are easily tamed.

The family Rhamphastidæ is divided into two genera—Rhamphastos, containing the true toucans, and Pteroglossus, containing the aracaris. The latter are distinguished by the smaller size of the bill, and by having a longer graduated tail. The general colour of these latter birds is also usually green, with red or yellow on the breast; while in the toucans the ground colour is nearly always black, with patches of white or brilliant colours on various parts of the body. The bill in both genera is generally gaily coloured; but the colours on this and the soft parts of the body are so evanescent that they generally disappear after death. The species are tolerably numerous.

The Red-billed Toucan (*Rhamphastos erythrorhynchus*) is a large species, measuring upwards of 20 inches in length. It has the lower mandible and the lower part of the upper one red, the base of both and the top of the upper mandible being yellow, with a black band separating the yellow parts from the red. The general colour of the plumage is black; the throat is white, bordered with red at the bottom; the upper tail-coverts are yellow, and the lower ones red.

This species is a common bird in Guiana and Brazil. Along the course of the Amazon, according to Mr. Edwards, it and the Ariel Toucan (*Rhamphastos ariel*) are the most abundant forms of this family, occurring in vast numbers throughout the forests in the autumn. When they alight, and begin climbing about the trees in search of fruits, one of them acts the part of a sentinel, continually uttering a loud cry of *tucáno*, from which their name is derived. When the whole flock raise their loud and not over-melodious voices in concert, they produce a harsh scream, which may be heard at the distance of a mile. Mr. Edwards tells us that these birds, when tamed, may be taught as many tricks as a parrot, but they are destitute of the faculty of speech.

The Aracari (*Pteroglossus aracari*) is nearly 17 inches in length. Its colour above is dull green, with the head and throat black, and the rump scarlet; the breast is scarlet, with a broad black band; the flanks yellow, the belly and legs green, and the lower tail-coverts pale yellow. It is a native of Brazil and Guiana.

TOUCH. The sense of touch belongs to the outward integument of the body—the skin—and is shared, in a minor and modified degree, by parts of the mucous membranes, which, at the various orifices of the body, are continuous prolongations of the same structure. By it we have the faculty of determining our immediate relations to material objects, in regard of contact, temperature, and electrical excitement.

In order to that high development of the sense of touch which we notice in the human hand, or in the proboscis of the elephant, certain anatomical peculiarities are required, viz.:—

1. An exposure of the largest possible number of points, each endowed with sensibility, and capable of being recognized in the sensorium as distinct and individual. Such a structure is eminently illustrated in the papillary surface of the skin, which presents a vast number of minute evolutions, or papillæ, every one furnished with its own fibrillary nervous loop, and a minute inosculation of blood-vessels.

2. The sense of touch requires for its perfection that a muscular apparatus should be connected with the sentient surface, by means of which this may adapt itself to the superficies of bodies, in order to explore their outline, span their dimensions, or probe their texture. And we find accordingly in those organs which are most tactile—the hand, the tongue, the lips of the human subject, the snout, proboscis, or tentacles of lower animals—that complicated muscular motions belong to the part, and render it a more available instrument of exploration. The importance of this addition becomes manifest if we apply a foreign object to any plane surface of the body (to the front of the forearm, for instance), and hold it there without pressure or motion. The only sensation so conveyed is one of indefinite contact: without pressure we know not its consistence; without successive and exploring movement we cannot ascertain its outline or level. The amusing facility with which illusions of touch are produced is treated of and illustrated in the article ILLUSIONS.

TOUL, a town of France, in the department of Meurthe et Moselle, which stands at the foot of vine-clad hills, in a fertile plain on the Moselle, here crossed by a stone bridge of seven arches, at a distance 13 miles west from Nancy. The population in 1886 was 8088. The town is irregularly built, but contains some good structures. Among the objects deserving of notice are—the cathedral, which contains some fine sculptures, and is one of the most famous Gothic edifices of the sixteenth century: the external walls were much injured, and a large window destroyed, during the bombardment by the German army in 1870; the Church of St. Gengoult, the town-hall, the two hospitals, the barracks, the corn market, and the ramparts, which are flanked with nine bastions. This town is noted for its embroidery; calicoes, hardwares, pottery, beer, and leather are also made. Near it is a chalybeate spring. Toul is a fortified town of the third class, and has a station on the railway from Paris to Strasburg. The city and diocese acquired great privileges from Charles the Simple in 925, when it was united with the German Empire. It was re-united with France in 1552. In the Franco-German War of 1870, the town only surrendered after a gallant resistance.

TOULON, a large maritime town, military and naval arsenal, and a fortified place of the first class, in the French department of Var, is situated about 34 miles E.S.E. of Marseilles with which it is connected by the railway, and in 1886 contained 57,635 inhabitants. It stands at the head of an inlet from the Mediterranean Sea, on a gentle slope at the foot of high hills, which inclose it on all sides except the south. The inlet is divided into two parts (the inner and the outer road) by two headlands, which approach each other so as to form a strait. These roads are safe, well sheltered, and capable of receiving the largest vessels. On the north side of the inner road, and formed by strong moles, are two harbours, one for commerce and the other for the navy, which communicate with each other by a deep channel crossed by a swing bridge, and with the inner road by two narrow entrances passable by only one vessel at a time. The moles are hollow and bombproof, and formed externally into batteries on a level with the water. The commercial port, the more eastern of the two, was constructed by Henri IV., and is surrounded by handsome quays. The naval port, which was formed by Louis XIV., and the naval arsenal, occupying 240 acres, contains stores, forges, cannon foundries, armouries, covered slips for building ships, various naval schools, and all the establishments and machinery necessary for the construction, rigging, and fitting out of ships of war of all sizes. The ropewalk, built with cut stone, and covered with a vaulted roof, is 1100 feet in length. On the south-east and eastern moles of the naval port are the bagne and hospital for convicts; in front of these are repairing docks. The artillery depot is on the west side of the harbour. On the land side the town and harbour are strongly defended.

The town is entered by the Gate of Italy on the east, and by that of France on the west; and it is divided into the old and new quarters. The latter lies north of the Port Neuf, or naval harbour, and contains all the splendid buildings connected with the dockyard; the Place d'Armes, a spacious and handsome square, bordered with rows of gigantic elm and plane trees; the Place St. Roch, at the entrance from the west; the theatre and the marine hospital, besides several straight, regular, and well-built streets. In connection with the naval hospital are schools of naval medicine and pharmacy, an observatory, and a museum of natural history. In the Place d'Armes is a large building forming the residence and offices of the maritime prefect. The old and larger part of the town lies opposite the commercial port. The handsome street fronting the harbour contains the town-hall, a commanding edifice, the balcony of which is supported by two fine statues sculptured by Puget. The Cours—which runs from the harbour past the former cathedral into the Rue Lafayette, the principal street—forms a long symmetrical promenade, bordered with trees. To the east of this place the streets are wide, straight, and regular.

The principal ecclesiastical structures of Toulon are—the former cathedral, now called Eglise Majeure, which has a handsome façade, and contains some good sculptures by Puget; the churches of St. Louis, near the Place d'Armes (which presents a commanding portal and colonnade), and of St. Jean and St. Pierre. Adjacent to the Eglise Majeure is a fine building now used as a college. The

land artillery depot, which occupies one of the bastions on the north, the barracks, the hospitals, the public library, the court-house, and the vast fish-market, the roof of which is supported by enormous pillars, are also deserving of notice. The town also contains civil, commercial, and marine tribunals; a custom-house, a chamber and general council of commerce, an observatory, learned society, maritime museum, theatre, &c. Owing to its situation at the foot of high, bare hills, that intercept the winds from the north and reflect the sun's rays, the climate is often extremely hot. The mean temperature of the year is 62·2°; in winter 48·5°, and in summer 75·2° Fahr.

The industrial products and commerce of Toulon, independent of its connection with the great naval establishments it contains, are not very important. Woollen cloth, hosiery, soap, candles, leather, and chocolate are the chief manufactured articles; shipbuilding is also carried on.

Toulon existed as a harbour in Roman times, under the name of *Telo Martius;* it gave title to a bishop from the fourth century to the first revolution, when the see was suppressed. On the 16th of August, 1793, the royalists of Toulon admitted from the English and Spanish fleets, then cruising off the port, a detachment of soldiers, who, subsequently reinforced and commanded by General O'Hara, held the place till 19th December of the same year, when it was taken by the republican army after a siege and bombardment by General Dugommier, under whom Napoleon Bonaparte directed the artillery and displayed the first decided proofs of his military genius. It was from Toulon that Napoleon sailed for his memorable campaign in Egypt, in 1798; and the French army destined for the conquest of Algeria also embarked here in 1830. In 1855 the convict prison was made a depot for Russian prisoners of war.

TOULOUSE, the capital of the French department of Haute-Garonne, is situated on a broad, pleasant, and fertile plain, on the right bank of the Garonne, just above the point where that river is joined by the Canal du Midi, 140 miles by railway south-east from Bordeaux, and 430 south from Paris. The population in 1886 was 136,882. The large suburb of St. Cyprien, on the left bank of the river, is connected with the city by a handsome bridge. This part of Toulouse was almost entirely destroyed by an inundation of the Garonne in 1875. Upwards of 1000 persons were drowned or killed by the falling houses; more than 20,000 were rendered houseless; three bridges were swept away, and property to the extent of millions was destroyed. Previous floods had occurred in 1815, 1835, and 1855, but that of 1875 was by far the most disastrous. A canal unites the Garonne with the Canal du Midi. The point of junction is crossed by a bridge adorned with bas-reliefs, which forms the termination of a magnificent alley of trees running along their banks. The old fortifications of Toulouse have nearly disappeared, to make way for modern improvements. The greater number of the houses are high, and built of red brick in a rambling style. Some of the old streets are narrow, crooked, ill-paved, and dirty. There are a few handsome places or squares, and several interesting structures. Among the former, and nearly in the middle of the city, is the Place de Capitole—a handsome square, adorned with a fountain at each angle—which is the chief market-place, and the point on which the main streets abut. The Place Lafayette presents a circle of uniform buildings, with a magnificent fountain in the centre; and a fine public walk, composed of three parallel alleys of trees, leads out of it to the Canal du Midi. The Place de la Trinité is also adorned with a very handsome fountain. Besides these promenades must be named the Cours Dillon, along the left bank of the Garonne; the magnificent avenue of the Porte Neuve; the Esplanade, the alleys of which radiate from a circular green ornamented with a *jet-d'eau*; the public gardens, and the botanical garden, the largest and finest in France, next to that of Paris. On the isle of Tounis, which is opposite the town and covered with buildings, are the ruins of the Castle of Narbonnais, the residence of the old counts of Toulouse.

The principal religious edifice is the Cathedral of St. Etienne, which consists of a nave built in the commencement of the thirteenth century, and a choir erected at the beginning of the seventeenth. The Church of St. Serin, or St. Saturnin, is built on the site of a very celebrated temple of Apollo. It is in the form of an elongated cross, and in the Roman style. It is the oldest, most perfect, and most richly decorated ecclesiastical structure in Toulouse. It is surmounted by a lofty tower and spire, and contains many curious bas-reliefs, sculptures, and carvings. In the church of La Daurade, which is the burial-place of Clemence Isaure, and which has a very handsome interior, the gold and silver flowers of the successful competitors in the floral games were blessed. See CLEMENCE ISAURE.

The capitol, or town-hall, said to have been originally founded in the time of Galba, situated in the Place du Capitole, is a handsome modern building of the Ionic order, with an octostyle portico of red marble; it is 394 feet long, 130 high, and contains a theatre, besides the municipal buildings. The residence of the prefect, formerly the archiepiscopal palace, is a fine modern building. The museum contains a good collection of pagan and Christian antiquities. Among the other structures of the city, the court-house, which is the old parlement house of Toulouse with the exterior modernized; the observatory, veterinary college, abattoir, public library, in which are 70,000 volumes; school of artillery, barracks, arsenal, powder mill, cannon foundry in the former nunnery of Sainte Claire; hospitals of St. Joseph and Hôtel Dieu, together capable of receiving 2000 patients; guard-house, Calvinist chapel, Jewish synagogue—are the most remarkable.

Toulouse is the seat of a high court, which has jurisdiction over the departments of Haute-Garonne, Ariège, Tarn and Tarn-et-Garonne; and of a university-academy, with faculties of law, science, literature, and Calvinistic theology. Among its literary and scientific institutions are—a school of law, a national academy of sciences, inscriptions, and polite literature, an archæological society, a society of the fine arts, a secondary school of medicine, a veterinary college, a school of gunnery, the academy of the Floral Games, the institution of which dates from 1323; a diocesan seminary, normal school, and Catholic, Protestant, and Jewish colleges. An archbishop resides in Toulouse; his see is co-extensive with the department of Haute-Garonne.

The industrial products of Toulouse are of great variety, including coarse woollen cloth, blankets, silk goods, gauze, starch, straw hats, vermicelli, wax candles, musical strings, paper, pottery, scythes, steel, and hardware; it has a large porcelain manufactory, cotton yarn mills, dye-houses, several printing offices, brandy distilleries, copper and iron-foundries, tan-yards, cannon-foundry, powder mill, and a tobacco factory. The town is noted throughout the south of France for its duck-liver and truffle pies.

Toulouse is one of the most ancient cities of Gaul, and stands on the site of *Tolosa*, the capital of the Volcæ Testosages, a Celtic tribe. On the formation of the kingdom of Aquitaine by Charlemagne, Toulouse was chosen to be its capital. In the middle ages the city was governed by counts of its own, and suffered terribly for favouring the Albigenses, from the sieges, plunderings, and massacres of Simon de Montfort, who was at last killed under its walls. A hard-earned victory was gained here by the Duke of Wellington in command of the Allied Army, over the French commanded by Marshal Soult, 10th April, 1814. An obelisk on a hill, outside the town, marks the marshal's position during the engagement. There is also a monument to Colonel Forbes; and several tablets bearing English names are in the Protestant church of the city.

TOURA'CO (Corythaix) is a genus of scansorial birds belonging to the family Musophagidæ (PLANTAIN-EATERS). The Touracoes are distinguished from the true Plantain-eaters (Musophaga) by the smaller size of the bill, which has the nostrils situated at its base, and by the large and beautiful crest on the head, which can be elevated and depressed at will. The White-crested Touraco or Louri (*Corythaix albocristatus*) is a native of South Africa, where it is common in forests and wooded districts, frequenting the highest trees, and rarely, if ever, descending to the ground. It is about 19 inches in length. The general colour is grass-green, with a broad white tip to the feathers of the crest; beneath the eye is a white streak; the abdomen is blackish, and the quill-feathers are brilliant carmine. Its food consists wholly of fruits.

An allied genus, Schizorhis, contains some birds sometimes called False Touracoes. They are generally of a uniform gray colour, without the beautiful red colour of the primaries, found in all the species of the genus Corythaix. The Gray False Touraco (*Schizorhis concolor*) is also found in South Africa, but in different districts to the preceding species. It is found in small flocks, climbing about the trees like the colies of the same regions. It feeds on berries, seeds, and fruits, and also on insects. The head is furnished with a long crest, which is erected when the bird is disturbed or alarmed.

TOUR'GUENIEFF. See TURGUENIEV.

TOUR'MALINE is a dark mineral, usually of a brownish or greenish hue, but sometimes tolerably transparent, and light blue, red, or colourless. It consists of silicate of alumina, with a proportion of magnesia, lithia, potash, soda, iron, or lime, in different amounts according to the variety. It usually occurs in the form of three-sided or six-sided prismatic crystals, belonging to the hexagonal system, and is met with embedded in granites, gneiss, schists, and altered limestones. Having but a slight lustre, and being often cloudy, the mineral is rarely of value as a gem, though in hardness it slightly exceeds quartz, and the red variety occasionally forms a precious ornamental stone. Tourmaline, however, is of the greatest importance to the physicist on account of its optical and electrical properties. The principal supplies in commerce are obtained from Brazil and Ceylon, but other important sources are the mines of Siberia and Elba; and a black opaque variety, termed SCHORL, is common in almost all granites.

TOUR'NAMENT (Fr. *tournoi*, from *tournoyer*, *tourner*, to turn), a mediæval military sport and chivalrous pastime, designed to exhibit the skill, address, and courage of knights and nobles on a public field. Its invention has been attributed to Geoffrey de Preuilly, ancestor of the counts of Anjou, about the middle of the tenth century, but it would seem to have naturally grown out of the martial exercises in which the early feudal warriors delighted. One would prove his skill against another in a *joust* or *just* (a friendly passage of arms), and thence would form a desire to display his prowess before applauding eyes. But a single combat would offer little entertainment to a crowd of spectators, and consequently, on these occasions, several knights would agree to enter the lists against each other. We have thus the tournament in its earliest and simplest form. As feudalism became more luxurious and chivalry a recognized institution, with its laws and decrees which none dared controvert, we find it assuming far grander proportions. Kings and queens, lords and ladies, gentles and commoners, assembled for the purpose of watching, criticising, and rewarding the combatants in these martial games: the galleries glowed with jewels and costly raiments, and every knight burned with impatience to prove his address before the fair and noble ladies,

> "Whose bright eyes
> Rained influence, and adjudged the prize."

The tournament, in fine, grew into the georgeous and picturesque spectacle of which we obtain so many vivid glimpses in the pages of Froissart and Monstrelet, and which has been painted with such vigour by Sir Walter Scott in his "Ivanhoe," and Lord Lytton in his "Last of the Barons." And lastly, as the spirit of chivalry died out, and feudalism lost all its pith and stamina, the tournament degenerated into a mere display of regal luxury, or into a sumptuous state pageant, such as made renowned the Field of the Cloth of Gold in the reign of Henry VIII., or formed part of the marriage festivities of Philip II. of Spain and Queen Mary of England.

The tournament was usually held at the summons of some prince or powerful baron, who sent a herald to foreign courts intimating the day and place at which he would be prepared to "break a lance" against all comers, and inviting the most illustrious knights to favour him with their presence. An arena for the performance of the usual martial feats was then marked out; galleries were erected for the accommodation of spectators; and around the spot the intending combatants pitched their tents, suspending above the entrance of each the armorial shield and banner of its occupant. The weapons generally used were blunted lances or swords, and the warriors fought on horseback, sometimes dismounting, however, to finish the engagement on foot. Prizes were distributed to the victors by the presiding prince or noble, or by some fair lady to whom this pleasant task was intrusted, and who received the title of Queen of Love and Beauty. Every combatant was required to be of gentle birth, and was bound to obey the minute regulations framed by the heralds for the orderly conduct of the tournament. He was encouraged to excel in

> "The fine vocation of the sword and lance"

by the smiles of the ladies, the warlike exhortations of the heralds, and the approving shouts of the spectators.

The palmy days of tournaments were in the thirteenth, fourteenth, and fifteenth centuries; in the sixteenth they sank into mere court spectacles, from which not only the life but the meaning had departed. One of the last grand displays in England was celebrated at Smithfield in 1467, when Count de Charolois, the Bastard of Burgundy, challenged the gallant Antony Woodville, Lord Scales, and got the worst of it. The lists, or inclosed area, on this occasion measured 380 feet in length by 260 in breadth. Of the costly pageants in which Henry VIII. and his courtiers loved to figure lively records will be found in Hall's "Chronicles." After the death of Henry II. of France, in 1559, which was the result of the loss of an eye at a tournament, they were wholly abandoned, and the only attempt made to revive them took place at Eglinton Castle in Ayrshire, in 1839, under the superintendence of the Earl of Eglinton. Though organized on a scale of considerable splendour, it was felt to be strangely discordant with the spirit of the age, and invoked a storm of ridicule and obloquy. It is wise not to meddle with the dry bones of feudalism, which can never again be galvanized even into a temporary life.

TOUR'NAY (*Doornik*), an important town in the Belgian province of Hainault, is situated on the Scheldt, 60 miles by railway south-west from Brussels, 12 east from Lille, and had 34,274 inhabitants in 1886. St. Jerome mentions it, under the name of *Tornacus*, among the towns seized by the barbarians. It was for some time the capital of Clovis. Its history from 1513, when it was taken by Henry VIII., presents a succession of sieges, the most important of which was that of 1581, when, having revolted against Spain, it was taken by the Duke of Parma. The Scheldt divides Tournay into two parts, the old town on the left bank (occupying the site of the ancient *Tornacus*), and the new town on the right, which is distinguished by the neatness and tolerable straightness of its broad

streets, its well-built houses, and its handsome quay, planted with trees. The Cathedral of Notre Dame in the old town is a large and handsome Gothic building. The interior is adorned with the richest carving and sculpture. The Church of St. Martin, the episcopal palace, the gallery of art, the citadel, the athenæum, the town-hall, the bell-tower, and the hospital for old clergymen, are among the other principal edifices. The town has several handsome suburbs. The manufactures comprehend cotton yarn, printed cottons, dimities and other cotton goods, a royal factory for Brussels carpets, hosiery, linen, swanskin, paper, hats, leather, earthenware, porcelain, oil, liqueurs, bronze, &c. There are dye-houses, lime-kilns, and several large flour mills, a considerable trade being carried on. The Scheldt is navigable to the town for vessels of 150 tons. A public library, museum of natural history, subordinate court of justice, commercial court, chamber of commerce, exchange, theatre, bank, orphan-house, lunatic asylum, several hospitals, schools, and churches, besides those already mentioned, are among the other noteworthy institutions of the town. Tournay is a bishopric which dates from the fifth century. In 1863 a bronze statue was erected in the grand square to the memory of the Princess Espinoy, for her noble defence of the city during the siege of 1581.

TOURNEUR, CYRIL, one of the later poets of the great Elizabethan cycle of dramatists, wrote only under James I. He has really grand tragic genius, and it is certainly unfortunate that only three of his plays are still extant. These are the "Atheist's Tragedy," "Revenger's Tragedy," and the "Nobleman." The last is somewhat doubtful as to Tourneur's entire authorship. Scarcely any reliable particulars exist as to his life, genius though he was. In any other period but this, unrivalled in splendour in all our literature, Tourneur would have taken highest rank; and even in contrast with the other giants of his time he still commands our admiration. More splendid success in pure dramatic dialogue has not been achieved by Shakespeare or by Webster than by Tourneur in his happiest moments, in the opinion of one of the masters of modern verse (Swinburne). And elsewhere the same poet-critic has recorded that "in mere style, in commanding power and purity of language, in positive instinct of expression and direct eloquence of inspiration, the author of the 'Revenger's Tragedy' stands alone in the next rank to Shakespeare." Charles Lamb also held Tourneur exceedingly high. The "Revenger's Tragedy" has been frequently reprinted in collections. A cheap and excellent edition of Tourneur appeared in the Mermaid Series of the Great Dramatists in 1887.

TOUR'NIQUET, an instrument used by operating surgeons for the mechanical compression of a bloodvessel in order to prevent hæmorrhage. The invention of this instrument is ascribed to a French surgeon named Morel, and in its earliest form it consisted of a strong bandage, which was placed round the wounded limb, and tightened by twisting round a stick which was placed within it. In the early part of the seventeenth century another French surgeon named Petit designed a tourniquet, consisting of two metallic plates, which could be separated from one another by means of a screw, so as to tighten a strap which was connected with them and also encircled the limb. The common tourniquet now in general use is based upon that of Petit, and it consists of a firm, narrow, flat pad to compress the artery, a strong band to pass round the limb, a bridge furnished with rollers over which the band passes, and a screw which raises the bridge and thus tightens the band. When applied care must be taken to direct the pressure, so as to compress the artery against the adjacent bone. Signoroni's tourniquet, called also the Italian or horse-shoe tourniquet, consists of an arc of steel with a hinge joint in the middle, larger than the limb, having an expanded piece to rest against the side opposite to the artery, while a screw, carrying a pad, is directed against the artery from the opposite side of the arch. Tourniquets are very useful in the absence of skilled assistance, but most surgeons prefer to have the artery compressed during an amputation by an assistant, the tourniquet being liable to accidents which cannot be instantly repaired. In cases of accident, when a large vessel in one of the limbs is severed or wounded, a rough tourniquet may be extemporized with a handkerchief and stick, the latter being placed within the bandage and twisted round until sufficient pressure is obtained.

TOURS, a town of France, the capital of the department of Indre-et-Loire, is situated on the south bank of the Loire, on a plain which lies between that river and the Cher, 65 miles by railway south-west of Orleans. In 1886 it had 51,467 inhabitants. Tours, as well as Touraine, takes its name from the *Turones*, a Celtic tribe, of whose capital, *Cæsarodunum* or *Cæsaromagus*, it occupies the site. The entrance to the city from the Paris road is by a magnificent stone bridge of fifteen arches, 475 yards in length and 16 yards wide, across the Loire into a spacious square. Through this a street runs right across the town in its widest part, and terminates in a bridge which crosses the Cher into the Poitiers road. The Loire at Tours is also crossed by two suspension bridges. The ramparts on the side next the Cher are laid out so as to form the fine promenade called Le Mail. The wide quays along the Loire, which is joined to the Cher by a canal, are a great ornament to the town; and some important works have been constructed to prevent the danger from inundations of the Loire, which were formerly very great. Tours is the terminus of railways from Paris, Bordeaux, and Nantes. The most remarkable structures are—the cathedral, in the Gothic style of architecture, built by Henry V. of England, and dedicated to St. Gratien, the first bishop of Tours, the portal of which contains a magnificent rose window, and is surmounted by two towers 263 feet in height; two lofty towers in the Rue St. Martin (one containing a clock, and hence called Tour d'Horloge, and the other called Tour de Charlemagne, from the belief that Charlemagne's queen was buried beneath it), which are the only remains of the great cathedral of St. Martin de Tours, founded by St. Martin; the churches of St. Clement and De la Riche; a theatre, the episcopal palace, the court-house, the college buildings, the general hospital, and the residence of the prefect, which also contains a public library of 40,000 volumes and several valuable manuscripts. Tours has a tribunal of first instance, a tribunal and chamber of commerce, one communal and two ecclesiastical colleges, a botanic garden, and several literary and scientific societies. The chief manufactures are woollen cloth, silk stuffs (in which an important trade is carried on), ribbons, serge, carpets, small wares, wax candles, woollen yarn, leather; the commerce is composed of these articles and of corn, wine, brandy, plums, and dried fruit, hemp, wool, &c. Tours had in the middle ages one of the most important mints in France, in which were coined the *livres tournoises*, often named in history, and each worth a franc; and the first mulberry trees were planted here in France by Henri IV. There is a large printing establishment, which has produced some very fine works. In one of the suburbs, called Riche, stood the castle of Plessis les Tours, in which Louis XI. died, and which has been rendered famous by Sir Walter Scott's novel of "Quentin Durward;" the keep is the only part of the edifice now standing. At Mettray, near the town, is a voluntary establishment for the reformation of juvenile offenders, which has deservedly acquired great repute. The city of Tours has always been a favourite abode with the English, and contains a large number of good houses. When Paris was invested by the Germans in 1870 a portion of the government of defence went to Tours, together with the representatives of foreign powers. They

were afterwards joined by Gambetta; but the government removed to Bordeaux after the defeat of the army of the Loire near Orleans.

TOUS'SAINT, L'OU'VERTURE, a negro chief of extraordinary abilities, was born in St. Domingo, on the plantation of the Count de Noë, in 1743. His parents were slaves—his father, who was the son of an African king, having been taken prisoner by a hostile tribe and sold into slavery. Toussaint was taught to read and write by a fellow slave, who had been instructed by some benevolent missionaries. His integrity, talents, and acquirements gained him the complete confidence of his master, who appointed him superintendent of the other negroes on his estate. When the insurrection of the blacks of St. Domingo took place in 1791, Toussaint took no part in the atrocities which marked the struggle, but he contrived to save the lives of his master's family, and at great risk to himself he secured their escape from the island. He then joined the insurgents, and at once assumed a leading rank in their army. The other chiefs became jealous of his rapidly extending influence, but he ultimately triumphed over their intrigues, and attained to the supreme command. He at first deemed it prudent to co-operate with the Spaniards, who occupied a portion of the island, and rendered them important aid in their contest with the French republicans. One of their commissioners said of him—"Cet homme fait ouverture partout" (That man makes an opening everywhere)—which led to his being called by the name of Toussaint L'Ouverture, or Toussaint the Opening. But on receiving intelligence of the decree of the French Convention of 4th February, 1794, by which the abolition of negro slavery was confirmed, he quitted the Spanish service and joined the French general Laveaux, governor of the colony, and was elevated to the rank of brigadier-general. He assisted in bringing the island again under the dominion of France, and in 1795 rescued Laveaux from the mulattoes, who had revolted and thrown him into confinement. In gratitude for this service the French general appointed Toussaint lieutenant-governor of the colony, declaring his resolution, at the same time to act by his advice in all matters, whether civil or military. A great improvement soon followed the appointment of Toussaint to this important office. He formed a regular army of black soldiers and officers, disciplined after the European model; established the reign of law and justice; constrained the negroes to labour steadily and diligently, though every trace of personal slavery was abolished; revived trade and commerce; erected churches; established schools; and by his integrity, skill, and prudence, changed the whole aspect of the country. The British, who had landed in St. Domingo in 1793, still retained possession of several of its strongholds, but Toussaint exerted himself with such vigour and success to clear the island of their troops, that in 1798 General Maitland entered into a treaty with him for its evacuation, and in the name of the King of Great Britain presented Toussaint with a costly service of plate and two brass cannons. He soon after suppressed a formidable insurrection of the mulattoes, and in 1799 received from the First Consul a confirmation of his authority as commander-in-chief at St. Domingo. But after the peace of Amiens in 1801, Bonaparte formed the resolution of overthrowing Toussaint and taking possession of St. Domingo, alleging privately to his minister Forfait, who remonstrated against the nefarious project, that he wanted to get rid of 60,000 men. He accordingly sent a powerful fleet, having on board 35,000 troops under General Leclerc, with orders to reduce the island to submission. Toussaint and his followers resisted the invaders for a time with valour and skill, but being overpowered by numbers, they were gradually driven out of all their principal positions. Some of Toussaint's principal officers also deserted him, seduced by the flattering and insidious promises of the French general, and were followed by the great mass of the negro population. The intrepid chief, thus left almost alone, was at last obliged to submit, and retired to a farm in the interior, leaving the French acknowledged masters of the island. But in compliance with the orders of Bonaparte, Toussaint, while residing peaceably at his home, was treacherously arrested, and along with his wife and family carried at midnight on board the *Hero* man-of-war and conveyed to France. On his arrival at Brest, June, 1802, he was separated from his family, and confined in a dungeon in the Castle of Joux among the Jura Mountains, where he was treated with great severity. After an imprisonment of ten months, Toussaint was found dead in his dungeon on the 27th April, 1803; but the manner of his death is enveloped in mystery. The inhuman and dastardly treatment of this heroic chief is one of the blackest crimes perpetrated by Napoleon.

TOWER. See CAMPANILE.

TOWER OF LONDON. See LONDON.

TOWER POUND. See POUND.

TOWERS, ROUND. See ROUND TOWERS.

TOWN, in its popular sense, is an assemblage of adjoining, or nearly adjoining houses, to which a market is usually incident. In legal language "town" corresponds with the Norman "vill," by which latter term it is frequently spoken of, in order to distinguish it from the word town in its popular sense. It is more usual now to use the word "township" in this sense. A vill or town is a subdivision of a county, as a parish is part or subdivision of a diocese. The vill, the civil district, is usually co-extensive with the parish, the ecclesiastical district; and, *primâ facie*, every parish is a vill, and every vill a parish. Originally, the word town (Old English *tun*, from *tynan*, to inclose) meant an inclosure of the farm and farmhouse by a hedge, and finally a collection of houses. Towns began to exist as municipalities in Germany in the time of the Emperor Henry the Fowler (919–936), who caused all the important villages to be surrounded with walls or earthworks and ditches, as a defence against the Huns. Certain of the landless freemen were compelled to reside in these towns, while others were attracted by the privileges he conferred. These were in the nature of charters or contracts with the inhabitants, and had reference to various subjects. The germ of the town thus planted grew vigorously. The princes and bishops of the empire created towns on their own fiefs and benefices, and granted charters. For several hundred years thereafter municipal charters were granted in Europe at the political, military, or financial convenience of the ruling powers. In Spain the Christian kings created towns and granted municipal charters on the frontier as the territory was slowly reconquered from the Moors. In England charters were granted liberally by King John, to enlist the common people on his side in his contests with the barons; and in France by Louis the Fat for similar reasons. Sometimes municipalities were chartered as a means of increasing or more conveniently collecting the king's revenue. In Holland the municipal system embraced nearly all the territory and population. In Germany leagues of the free towns were formed, either for common defence or for commercial purposes. Of the former, the Swabian League and the League of the Rhine were the most important; while of the latter, the League of the Hanse Towns, or the Hanseatic League, was the most remarkable and most powerful confederation of municipalities that ever existed.

The rise of the English towns is as interesting a feature of English constitutional history as was the enfranchisement of the plebs in the history of Rome. The Norman conquerors quickly found that it paid them better to interfere little with the large towns, which possessed strongly the old English love of liberty, beyond appointing the portreeve to rule the citizens and collect the royal dues, with which view as many as possible were included by

William the Conqueror in the royal demesne. The stout burghers, who were restless and insubordinate to royal authority, were quiet and peaceable enough when allowed to elect their justices among themselves, and to manage their trade guilds their own way. Very large privileges indeed were granted to London as early as Henry I., and the charter of London was always looked to as the prime exemplar for other charters. London even had its local militia, but in this it stood alone. In all boroughs, however, the wise policy of Henry I. gave the townsmen customary tenancy, and withdrew them as far as possible from any arbitrary dealings on the part of the lord of the manor. Such were the boroughs of the royal demesne. As to the towns which grew around some great abbey or feudal castle, they lay long at the mercy of the lords whose protection they had sought; and it was the work of two centuries to buy or filch small privileges one after the other, until their own power and the needs of their lords were such that charters of complete liberty could be obtained. With the rise of Parliament (1265), and the call of the towns to take part in the government of the nation, as well as to contribute their share to the national burden of taxation, the future of the towns became assured.

The town guilds, fully described in the article GUILDS, gave a ready means to those mediæval English towns of learning the art of government; and it is invariable that greater security, liberty, and justice were to be found within their walls, arbitrary though they were in many ways, than in the country at large, ruled directly by royal officers or feudal nobles. The growth of the towns from the time of Henry II. was most rapid. The needs of the crusading Richard and the tyrannous John yielded golden profit against the hard cash of the townsmen in many a town which thus gained its independence. By the time of Henry III. the old guilds became merged in a "corporation" of mayor, aldermen, and councillors, elected by all kinds of different franchises in various places, each town developing for itself in true English fashion. Henceforward the constitutional history of the towns is best traceable in connection with that of MUNICIPAL CORPORATIONS.

The Tudors consistently adopted the policy of putting all the government of the towns into the hands of the corporation, and in many cases the parliamentary franchise also, thus gaining a large access of royal control over the House of Commons. This grew into such an evil that the occasion of the overthrow of the Stuarts was seized for the assumption of large rights by the townsmen in general. It was not until two years before his death that the astute Charles II. felt himself secure enough upon the throne restored to him to attack the great freedom of the towns. When Shaftesbury fell in 1683, and a burst of loyalty hailed the king's triumph over his foe, Charles took the first, and perhaps the only, direct step towards tyranny which he dared to make. He challenged the right of London to do many things which it had assumed the power to do, but which undoubtedly were not specified in its very ancient charter. London was condemned by the King's Bench, its charter was forfeited, and only restored upon humble submission and heavy fine. One or two similar judgments brought the towns to the king's feet, and he had the pleasure of reaping large harvests to the revenue; while at the same time he so manipulated the constitutions of the towns in their new charters as to render the royal interest predominant, and so control the House of Commons. In most cases the crown appointed the whole of the new corporation as a start. Fortunately, Charles died before he had done as much damage as he evidently wished to do; but the liberties of the towns remained seriously crippled in most cases until 1835, when the Municipal Corporations Act restored the burgesses to their ancient freedom and abolished the close corporations.

TOWN CLERK, an officer who keeps the records of a town or borough, and enters all its official proceedings. In Scotland the town clerk of a royal burgh acts as clerk to the burgh court, and as notary in all infeftments granted of burgage property.

TOWN'LEY MARBLES, the name of an assemblage of Greek and Roman sculpture which now forms a portion of the extensive gallery of antiquities in the British Museum. It received its appellation from Charles Townley, Esq., of Townley, in Lancashire, who began forming it at Rome as early as 1768—a period when excavations on the sites of ancient edifices were eagerly prosecuted. Having peculiar facilities for the purpose, Mr. Townley succeeded in bringing together a very choice collection of ancient marbles, bronzes, terra-cottas, gems, &c., and, after his death in 1805, his executors, in accordance with the terms of his will, offered these art-treasures to the nation. The government accepted the offer, and a vote of £20,000 was obtained for the purchase. The bronzes, coins, and gems were subsequently (1814) bought for £8200. The possession of the Townley marbles rendered necessary the erection of a suite of rooms to contain these and the previously acquired works of ancient art, and led to the creation of a new department, under the title of the department of antiquities. The collection was opened to the public in 1807, and was called the Townley Gallery; but since the rooms originally built for it have been swept away to make room for the present structure, the Townley marbles have been incorporated with the general collection of Græco-Roman remains, of which they form the most important portion, both as regards extent and character.

TOWNS, HEALTH OF. See SANITARY LEGISLATION.

TOXICOL'OGY. See POISON.

TOXO'TES. See ARCHER-FISH.

TOYN'BEE, ARNOLD, a social reformer, was the second son of Joseph Toynbee (1816–66), the well-known aural surgeon, and author of "The Use of the Artificial Membra Tympani" (1857), "The Deaf and Dumb" (1858), and "The Diseases of the Ear" (1860). Arnold Toynbee, who was born in 1852, was a favourite pupil of Professor Jowett at Balliol College, Oxford. He early interested himself in social questions, falling foul of the orthodox political economists, on the one hand, for their want of elasticity in dealing with great problems, and differing from the advocates of land nationalization, on the other hand, for being in many cases little more than noisy rhetoricians. He applied his economic doctrines successfully to land which he owned in Ireland, and worked assiduously, in spite of delicate health, among the poor of Whitechapel. His death was owing to the breakdown which followed the strain of two lectures which he gave in St. Andrew's Hall, Newman Street, London, on Henry George's "Progress and Poverty," with the Right Hon. Shaw Lefevre in the chair. Those who were present on these occasions can recall the absence of the physical power which should have accompanied the sublime intellectual enthusiasm which characterized the noble young fellow, who already seemed to have one foot in the grave. Toynbee died in 1883. Dr. Jowett has prefixed a short memoir of him to Toynbee's "Lectures on the Industrial Revolution in England," published after his death. The University Settlement in Whitechapel, Toynbee Hall, founded in great measure to further his theories of improvement, was named after him. Toynbee Hall reminds one of the monastic institutions of the middle ages. Many eager students from Oxford, intent on the regeneration of the London poor, have found their way into residence at the new settlement. To each of these a small bedroom is allotted, and the large dining-room, drawing-room, and well-stocked library are shared in common. The poor of the neighbourhood are invited to

lectures, classes, "at homes," and all that pertains to the civilization of the more well-to-do classes. There can be little doubt that this University Settlement has already achieved much good in the East End of London.

TRACHE'A (Gr. *tracheia*, which in its turn is derived from *trachus*, rough), is the cartilaginous and membranous tube called the windpipe, through which the air passes in the processes of respiration and inspiration. Its upper extremity, consisting of five cartilages, is called the *larynx*. The uppermost, or *epiglottis*, forms a kind of valve at the mouth of the larynx or glottis, and closes the passage in the act of swallowing. The sides of the larynx are formed by the arytenoid cartilages, and the anterior part of the *thyroid* and *cricoid* cartilages, whose annular or ring-like formation may be felt under the skin on the front of the neck.

Elastic ligaments unite these cartilages, which are acted upon by appropriate muscles, in such wise that the dimensions and form of the aperture may be suitably modified when the individual speaks or swallows, and they are kept moist by a mucous secretion.

The canal from the larynx downwards is called *trachea*, till it divides into the two bronchial tubes (*bronchiæ*) opposite the fourth or fifth dorsal vertebra. Their elastic cartilaginous texture, consisting of rings united by membranous and muscular fibres, keep them always open for the passage of the air.

In cases of suffocation an operation, called Tracheotomy, is now performed, and sometimes with success. For this purpose an incision is made in the trachea, and the obstacle which has closed the passage is removed. It is necessarily a difficult and dangerous operation, and should only be performed when the patient is of a robust constitution and healthy temperament. Inflammation of the trachea is now called *Trachitis*.

Tracheæ, in botany, the spiral vessels of plants, so called because they were regarded as their respiratory tubes. A vegetable tissue composed of tracheæ is named *tracheachyma*.

TRACHEL'IDA is a group of beetles belonging to the suborder HETEROMERA, distinguished by the exserted head, narrowed behind into a neck, and soft body. The wings are sometimes absent. In the perfect state these beetles are mostly vegetable-feeders, but a large number are parasitic in the larval state. The larvæ of the Oil-beetles (MELOIDÆ) are parasitic in the nests of bees, and some of them undergo a very complicated metamorphosis from the egg to the pupa state. STYLOPIDÆ is a very aberrant family, the females being wingless and inactive, living embedded in the bodies of bees and wasps. The Blister-beetles (CANTHARIDÆ) also belong to this group, which includes several other families, natives of America and other parts of the world.

TRACHEOT'OMY. See TRACHEA.

TRACH'YTE (Gr. *trachus*, rough) is a kind of volcanic lava so-called from its rough "feel." It contains from 60 to 80 per cent. of silica, and hence belongs to the "acidic" group of igneous rocks. In addition to the brown glassy substance and the crystalline-granular material which form the ground-mass, it contains more or less well-defined crystals of sanidine, oligoclase, hornblende, biotite, magnetite, titanic iron, tridymite, quartz, and others, and according to the prominence of certain of these the different varieties of the rock are named, *e.g.* Sanidine-trachyte, quartz-trachyte, &c.

TRACTA'RIANISM, the name usually given to an important movement which originated between the years 1833 and 1840 in the Church of England. The difficult position of the Established Church in 1830-32—its general unpopularity, arising out of the opposition of the clergy to the political changes then taking place, together with the increase in the numbers and political influence of the Nonconformists—led a body of serious and thoughtful churchmen to consider the position of the church, its danger, and the possible remedies. The publication of Keble's "Christian Year" in 1827 had produced a great effect upon churchmen in reviving their interest in certain elements of church doctrine, which had been thrust aside by the Evangelicals, and this little book is justly regarded as the *fons et origo* of the whole movement. But the year 1833 was the time, and Oriel common room was the scene of the birth of the Oxford revival. It found a voice on 14th July, 1833, in Keble's famous assize sermon at St. Mary's, on National Apostasy. "I have always," says Newman in his "Apologia," "considered and kept that day as the start of the religious movement of 1833." The founders and leaders of the new party which speedily arose in the church were the Rev. John Keble, author of the "Christian Year," Fellow of Oriel, and formerly professor of poetry at Oxford; Rev. J. H. Newman and Hurrell Froude, also Fellows of Oriel; the Rev. E. B. Pusey, Regius Professor of Hebrew, and canon of Christ Church; Rev. Isaac Williams, Fellow of Trinity; the Rev. Hugh Rose of Cambridge, and others. The chief spirit of the movement, however, undoubtedly was Newman, who began the celebrated "Tracts for the Times," from which the party derived their name, and of which he was throughout the editor, and to a large extent the author. The "Tracts," some of which were rather bulky volumes, were issued anonymously, and while they dealt with a variety of subjects, their chief aim was to discountenance Protestantism and to advocate the doctrines of apostolical succession, priestly absolution, baptismal regeneration, the real presence, the authority of the church, and the value of tradition. The study of the works of the fathers, and of ecclesiastical history, of ancient liturgies, &c., was greatly revived at the university and among the clergy, while the peculiar views of the Tractarians were promulgated with burning zeal and unwearied activity by means of learned treatises, by the "Tracts" already mentioned, and in periodical publications of all sorts, in magazines and newspapers, in pamphlets, letters, dialogues, novels, poetry, and history. From the first numerous converts were made, especially among the students and younger clergy, and as the party increased in numbers so did it increase in its influence and pretensions. Very soon the friends of Protestant and Evangelical views took the alarm, and a fierce controversy arose which threatened to rend the Establishment in pieces. The storm reached its height in the year 1841, when the famous "Tract, No. 90," was written and published by Dr. Newman in the month of February. The object of its author was to show that subscription to the thirty-nine articles need not prevent a man from accepting all the fundamental tenets of the Roman Catholic Church, and its publication was followed by a universal storm of indignation. The tract was denounced as deserving by right to be called the "Art of Perjury made Easy," and it was condemned by the Bishop of Oxford, and by a formal resolution of the vice-chancellor, heads of houses, and proctors of the University of Oxford in March, 1841. This event led to a termination of the series, and to the resignation by Dr. Newman of the vicarage of St. Mary's, Oxford. Two years later Dr. Pusey published his work, entitled, "The Holy Eucharist, a Comfort to the Penitent," in which the doctrine of the real presence is explicitly taught, which was also condemned by the university authorities, and led to the suspension of Dr. Pusey from office for two years. In 1845 Dr. Newman seceded to the Roman Catholic Church, a step which was also taken by Ward, Faber, Oakley, Manning, and others, though Keble and Pusey adhered to the Church of England to the last. With the secession of these important leaders, the controversy gradually terminated, but the influence of the movement, though less prominent and striking, continued to pervade the Established Church, and it has by no means

spent its force at the present day. One of its later developments has been noticed under RITUALISM.

TRACTION-ENGINE, a sort of locomotive steam-engine, used for dragging trains of carriages on common roads at moderate speeds, seldom exceeding that of an active draught horse. There are usually two driving wheels, and in order that they may move at a moderate speed while the engine-shaft turns at a comparatively high speed, motion is communicated to them from the engine-shaft through suitable toothed wheels or pulleys and gearing chains. The driving wheels, and the bearing wheels also, are made broad in the rim, so as to enable an ordinary roadway to bear the pressure of the load and the dragging action of the driving-wheels. To enable such engines to travel on loosely-made roads and soft ground, various contrivances are used. In some forms of engine the wheels are covered with an india rubber tire, protected by a species of open chain-mail from the stones, &c., of the roadway; in others one broad roller supplies the place of the two driving wheels. In other forms, each driving wheel carries a series of flat shoes hanging from pins in its circumference, so that during the rotation of the wheel these shoes are set down one after another before the wheel, thus making a temporary platform for it to roll upon. To prevent the driving wheels from slipping on the road as they turn, it is in most cases sufficient that their rims should be slightly roughened by means of projections or of transverse grooves; but when soft ground has to be traversed, the wheels are sometimes fitted with a set of blades or "spades," which can be made to project from the rim of the wheel or drawn back within it at pleasure. The engine is steered by means of one or of two bearing wheels, carrying a swivelling frame, whose position is regulated by means of suitable hand-gear.

The heaviest class of steam rolling machines for consolidating broken stone roadways resemble in their general construction traction-engines with broad rollers for wheels.

TRADE, BOARD OF, a department of the English government, originally established in the reign of Charles II. (1660) as a council of trade for keeping a control and superintendence upon "the whole commerce of the nation." At the close of that year there was created by patent a Council of Foreign Plantations; and in 1672 the two boards were amalgamated.

The original board was swept away by Act of Parliament in 1782, and its business was transferred to a Committee of Privy Council, whose duty was "to examine the Custom House accounts of all goods and merchandise exported and imported to and from the several ports in the kingdom, as well as from foreign ports, in order to inform the government of the advantages and disadvantages of the trade of this nation with other kingdoms and states in regard to the balance of trade. And also to encourage our plantations abroad by endeavouring to promote their trade; and by discovering and encouraging such branches as were most conductive to their respective interests, as well as to those of the kingdom at large."

In 1786 the Committee of Privy Council for Trade was abolished by order in council, and a new board established under the title of the Lords of the Committee of Privy Council appointed by his Majesty for the consideration of all matters relating to Trade and Foreign Plantations.

The department is under the direction of a president and parliamentary secretary, both of whom have seats in Parliament; the other members of the board or committee are—the lord chancellor, the first lord of the treasury, the principal secretaries of state, the chancellor of the exchequer, the Speaker of the House of Commons, the chancellor of the Duchy of Lancaster, the paymaster of the forces, the master of the mint, and such officers of state in Ireland as are privy councillors in England. Practically none of its members take part in its deliberations except the president and parliamentary secretary, as of late years the business of the board has been wholly conducted by the president, vice-president (now called parliamentary secretary), and the permanent secretary and his assistants.

The functions of the Board of Trade are partly of a ministerial, partly of a judicial character, and its duties are being constantly increased by fresh legislative enactments. It receives powers under the provisions of the Merchant Shipping Act, 1854 (17 & 18 Vict. c. 104), for the general superintendence of matters relating to merchant ships and their crews, and the carrying into execution of the statutes relating to them. From the passing of this Act dates the establishment of local marine boards at the chief ports of the United Kingdom for the main purpose of instituting and conducting examinations for persons wishing to qualify as masters and mates of merchant ships, and over which the Board of Trade have control. Under this Act provision is made for the registration of all vessels, and for the keeping of records of services of masters and mates by the Registrar-general of Shipping and Seamen. It also empowers the Board of Trade to grant licenses to persons to engage or supply seamen or apprentices for merchant vessels, to adjudicate on claims for wages, and to investigate cases of alleged incompetency and misconduct. The Merchant Shipping Act, 1876, which was passed after what is known as the Plimsoll agitation in the matter of unseaworthy vessels, provided for the periodical survey of ships by the Board of Trade, for which purpose surveyors are stationed at all the chief ports, and it is also a part of their duty to see that the regulations against deck cargoes and overloading are observed.

The Board of Trade also grants certificates to passenger vessels, and any owner whose vessel is employed in carrying passengers without such certificate, or with a larger number than is stipulated in the certificate, is liable to a heavy penalty. The Board of Trade exercises an almost paternal care over seamen; it assists them in every possible way to preserve their hard-earned wages for their wives and families, by offering them facilities for the transmission of their wages from one port to another, by means of what is known as the Transmission Scheme, and by seamen's money orders, which are issued *free* of expense at all ports in the United Kingdom, and for a small commission at all the British consulates abroad, and by shipping masters in India, &c. Thrift is further encouraged by means of Seamen's Savings Banks, established at the various ports under the Seamen's Savings Banks Act, 1856, in which interest at the rate of 2¼ per cent. is paid on all deposits. Should any of them fall ill or become distressed abroad through wreck or otherwise, he may, on application to the British consul or shipping master (in the colonies), be sent to hospital and nursed, or, if not ill, subsisted until an opportunity offers of getting him a passage on some homeward bound vessel. Should it be found that the seaman has been illegally left behind, or has been injured in service of the ship, the owners are applied to for repayment of the expenses.

The Board of Trade also exercises a supervision over the pilotage laws and regulations in the United Kingdom, sanctions the erection of British and colonial lighthouses, and maintains at coastguard stations and elsewhere round the coasts of the United Kingdom rocket apparatus for saving lives from shipwrecked vessels. It also deals with questions of wreck and salvage in the United Kingdom, taking charge of all unclaimed wreck and its proceeds; and by the Harbour Transfer Act, 1862, it is clothed with the same powers of supervision over works constructed along the seashore as were previously vested in the Admiralty.

By the Crown Lands Act, 1866, the administration

of the crown rights over the fore-shore and bed of the seas is, with certain exceptions, transferred to the Board of Trade. It also regulates the mode of obtaining grants of oyster and mussel fisheries, under the Oyster and Mussel Fisheries Act, 1866, and deals generally with questions affecting rights of international sea fisheries. The Board of Trade likewise exercises a supervision over railways and railway companies, not only in reference to their original formation, but also to their subsequent working. Railways were first placed under their control by the statute 3 & 4 Vict. c. 97. A few years afterwards the authority of the Board of Trade in this respect was transferred to a Board of Commissioners of Railways; but in 1851 all the powers were re-transferred to the former board (14 & 15 Vict. c. 64). Notices of application for railway Acts, accompanied by plans, must be deposited with this board before any bill can be introduced into Parliament; and before a line can be opened for traffic due notice must be given, and its permission obtained, on the report of an inspector. So when an accident happens official notification must be made to the board, who usually direct an inspector to inquire into the circumstances, and on his report such action is taken as is deemed necessary for the greater safety of the public. It also has to deal with the Provisional Orders with respect to piers and harbours, tramways, electric lighting, and gas and water companies. It appoints inspectors under the Alkali Act, 1863, and has the management of the department of weights and measures, which was transferred to it from the exchequer. Many matters relating to commerce, which emanate from other departments, are referred to it for information or advice, and frequent communications take place with the Foreign Office in the negotiation and working of commercial treaties.

The Board of Trade is further charged with the registration of all joint-stock companies, of life assurance offices, and of copyrights in designs, and under the Life Insurance Companies Act of 1870, with the audit of their annual accounts; it also controls the proceedings of the commissioners for regulating the employment of coal-whippers and the discharge of coal-laden vessels in the port of London. There is a department of the board concerned with the collection and preparation of the tables of prices of corn, which govern the rent charge in lieu of tithe under the Tithe Commutation Act. Two important measures which came into operation on 1st January, 1884, and known as the Bankruptcy Act, 1883, and the Patents, Designs, and Trade Marks Act, 1883, threw a great deal of new work on this important department. In connection with the former Act, the main object of which was to prevent fraudulent bankruptcies, officers, known as Official Receivers, were appointed in various districts throughout England and Wales for the purpose of carrying out its provisions. In spite of grumbling and discontent in some quarters, the Act may be said to have worked well. The accounts connected with every estate have to be submitted to the bankruptcy department every six months for audit. The Patents, Designs, and Trade Marks Act, 1883, the main purpose of which was to facilitate and simplify the grant and registration of patents, &c., placed the Patent Office which already existed under the direction of the Board of Trade, by whom a re-organization of the office was effected, followed shortly afterwards by a large addition to its strength, in the shape of qualified men who were to undertake the examination of applications for patents, &c. This increased cost to the state is, however, more than met by the fees received, and the same may be said of the bankruptcy department.

The Salmon and Freshwater Fisheries Act, 1886, has transferred to the Board of Trade the inspectors, formerly attached to the Home Office, whose duties it is to inspect and report on these matters. The Electric Lighting Act, 1882, promised at first a considerable increase of work, but the applications for provisional orders and licenses under this Act, which were numerous at first, have now almost entirely ceased, and until a fresh measure is passed which will hold out more encouragement and contain terms more favourable to promoters, it is extremely probable, nay, almost certain, that matters will remain *in statu quo*.

Lastly, a statistical department is charged with the collection and publication of tables containing classified information regarding the revenue, population, commerce, wealth, and moral and economical condition of the United Kingdom and its dependencies, the preparation of a selection from the statistics of foreign countries, and a monthly and annual account of trade and navigation. This latter contains a detailed statement of all imports, exports, and shipping, and is compiled at the Custom House, though published by the Board of Trade. In 1886, under the presidency of Mr. A. J. Mundella, a labour correspondent was appointed for the purpose of obtaining information as to the conditions of labour and pay in the various industries. In the same year was started a *Board of Trade Journal* containing information relating to the conditions of trade in different countries, prices of commodities, regulations affecting trade, &c., which is issued monthly; compiled from reports of consuls, &c. In view of the increasing importance of its extremely varied business, a legal department was added in 1876, previous to which the solicitor to the customs acted as solicitor to the Board of Trade.

TRADE MARKS. The fraudulent use of other persons' trade marks has led to the passing of several laws on the subject. The latest is the Merchandise Marks Act of 1887, which repealed a somewhat similar, but less stringent Act of 1862. Under the Act of 1887 every person who sells, or exposes for, or has in his possession for, sale, or any purpose of trade or manufacture, any goods to which any forged trade mark or false trade description is applied, or to which any trade mark or mark so nearly resembling a trade mark as to be calculated to deceive is falsely applied, as the case may be, is guilty of an offence against the Act, unless he proves—

That having taken all reasonable precautions against committing an offence, he had at the time of the commission of the alleged offence no reason to suspect the genuineness of the trade mark, mark, or trade description; and that on demand made by or on behalf of the prosecutor, he gave all the information in his power with respect to the persons from whom he obtained such goods or things; or that otherwise he had acted innocently.

The punishment is imprisonment, with or without hard labour, for a term not exceeding two years, or fine, or both imprisonment and fine; and on summary conviction to imprisonment, with or without hard labour, for a term not exceeding four months, or to a fine not exceeding £20; and in the case of a second or subsequent conviction to imprisonment, with or without hard labour, for a term not exceeding six months, or to a fine not exceeding £50; and in any case, to forfeit everything by means of or in relation to which the offence has been committed. The court before whom any person is convicted under this, may order any forfeited articles to be destroyed or otherwise disposed of.

The expression "trade mark" means a trade mark registered in the register of trade marks kept under the Patents, Designs, and Trade Marks Act, 1883, and includes any trade mark which, either with or without registration, is protected by law in any British possession or foreign State to which the provisions of the Patents, Designs, and Trade Marks Act, 1883, are applicable.

The expression "trade description" means any description, statement, or other indication, direct or indirect, as to the number, quantity, measure, gauge, or weight of any

goods, or as to the place or country in which any goods were made or produced, or as to the mode of manufacturing or producing any goods, or as to the material of which any goods are composed, or as to any goods being the subject of an existing patent, privilege, or copyright; and the use of any figure, word, or mark which, according to the custom of the trade, is commonly taken to be an indication of any of the above matters, is deemed to be a trade description within the meaning of this Act.

The expression "false trade description" means a trade description which is false in a material respect as regards the goods to which it is applied, and includes every alteration of a trade description, whether by way of addition, effacement, or otherwise, where that alteration makes the description false in a material respect, and the fact that a trade description is a trade mark, or part of a trade mark, does not prevent such trade description being a false trade description within the meaning of this Act.

A person is deemed to have forged a trade mark who, either without the assent of the proprietor of the trade mark makes that trade mark or a mark so nearly resembling that trade mark as to be calculated to deceive; or falsifies any genuine trade mark, whether by alteration, addition, effacement, or otherwise.

Every person who takes a watch case to any assay office in the United Kingdom for the purpose of being assayed, stamped, or marked, must make a declaration declaring in what country the case was made. If it appears by such declaration that the watch case was made in some country or place out of the United Kingdom, the assay office places on the case such a mark (differing from the mark placed by the office on a watch case made in the United Kingdom), and in such a mode as may be from time to time directed by Order in Council.

Every person who makes a false declaration for the purposes of this section is liable to the penalties of perjury, and on summary conviction to a fine not exceeding £20 for each offence.

All goods of foreign manufacture bearing any name or trade mark being or purporting to be the name or trade mark of any manufacturer in the United Kingdom, unless such name or trade mark is accompanied by a definite indication of the country in which the goods were made or produced, are prohibited to be imported into the United Kingdom.

Any person who falsely represents that any goods are made by a person holding a Royal Warrant, or for the service of her Majesty, or any of the royal family, or any government department, is liable, on summary conviction, to a penalty not exceeding £20.

TRADE SOCIETIES or **TRADES UNIONS.** A trade society, strictly speaking, is a combination of workmen to secure the conditions judged most favourable for labour by the general body of members.

The capitalist has the advantage of past accumulations in striking his bargain. The labourer, unassisted by combination, has not. It is the object of a trade society to give him this advantage, and to form the rank and file of our industrial armies into organizations able to deal on something like equal terms with the modern captains of industry.

As Mr. Burnett well says in his valuable "Report by the Labour Correspondent of the Board of Trade" (issued in 1887), "One of the most striking facts in the industrial history of the nation during the last sixty years has been the gradual self-organization of labour which has taken place. The great trades-union movement is expressly and specially the creation of labour for itself and for its own purposes."

Such societies are among the earliest and most persistent institutions of the human race. Allusions to a guild of apothecaries are to be found in the Old Testament (Neh. iii. 8). References to kindred associations are also found in early Roman history. Trade guilds undoubtedly existed in this country as early as the Saxon times, as they are referred to in the laws of Ina, Alfred, and Athelstan. The mediæval guilds, however, included employers as well as workmen, the distinction between the two then being very slight. See GUILDS.

The practice of fixing the rate of wages by statute commenced in the year 1350. A great plague having diminished the number of the labouring class, the survivors claimed to benefit by the absence of former competition, and to enjoy some advance of wages. A law to prevent this was at once passed, but seems to have been ineffectual. The first statute prohibiting combinations of workmen is the 34 Edward III. c. 9 (1361), but it dealt only with carpenters and masons. The first statute prohibiting workmen generally from entering into agreements among themselves as to the mode in which their work should be conducted was passed in 1549. This continued to be the only *general* enactment against associations of workmen for these purposes until 1799.

Towards the close of the last century the formation of workmen's societies received a new impulse from the introduction of improved machinery, and especially from the invention of the steam engine. These, by favouring the concentration of the leading industries in large establishments, gradually reduced many small masters to the position of labourers, and vastly increased the difficulty of rising from the working to the employing class. In this country unions were formed among the wool combers, cotton spinners, weavers, calico printers, scissors grinders, and men of other trades. As their influence soon began to be felt, new laws prohibiting such combinations under severe legal penalties were enacted in 1799 and 1800, but were evaded in various ways; and in 1824 a committee of the House of Commons reported that these laws had only produced irritation, distrust, and violence. They were accordingly repealed, and an Act was passed to protect combinations of workmen or employers from prosecution for conspiracy under the common law. At the same time severe penalties were imposed against interference with the freedom of individual workmen in the disposal of their skill and labour, as well as for the protection of the property and persons of masters and employers.

The necessity for such protection against intimidation and outrage may be vividly realized from the evidence obtained by the Royal Commission appointed at a much later period (1867) to investigate the subject.

Many trades unions were formed within a few years of the repeal of the Combination Laws. Their members at first had very exaggerated notions as to what they could effect, and extreme demands followed by strikes became frequent. As Professor Walker observes ("Political Economy," 1883), "The beginning of the century found the labouring classes of England almost destitute of political franchise, unaccustomed to discussion and the free communication of thought, tax-ridden, poverty-stricken, illiterate. What else than the series of fierce revolts, the rebellions of down-trodden labour, which followed Huskisson's Act of 1824, could, in an equal period of time, or, indeed, at smaller cost, have taught the employers of England to respect their labourers, and have taught the labourers of England to respect themselves; could have made the latter equally confident and self-reliant in pressing home a just demand, or made the former equally solicitous to refuse no demand that could reasonably be conceded?"

Toleration was really all that trades unions gained by the legislation of 1824. It was no longer criminal for a workman to belong to the union of his trade; but the union had no legal status in the law courts, and no legal protection for its funds, even when they were mainly designed for friendly or benevolent purposes. The old common law

interpretation of what constituted conspiracy was applied to strikes, and every member of a union arranging a stoppage of work of this kind was liable, under this doctrine, to transportation. Since then, however, incessant labour and agitation on the part of the workmen, largely assisted by the increased political power accorded to them, have resulted in the complete recognition and legalization of trades unions. A royal commission of inquiry into the constitution and working of trades unions was instituted in 1865. Their investigations led to the Trades Union Act of 1871, which provided for the registration of trades unions, and accorded a certain measure of protection for their funds, which had previously been pretty much at the mercy of their officers, as these societies, having no legal status, were unable to secure a conviction in case of dishonesty. But this measure was accompanied by a Criminal Law Amendment Act, which practically destroyed its effect, by reviving the legal disability of trades unionists in another form, and many of the most important unions refused to register themselves. Another vigorous agitation ensued, and in 1876 the passage of Mr. Mundella's Trades Union Act Amendment Act repealed every legal grievance of which the unions complained, with the result that to-day a large proportion of the trades societies in the kingdom are duly registered, and stand in much the same position as other trade corporations. At the same time, by the repeal of the old Master and Servant Act, another grievous social inequality was removed of which workmen had long complained. Under this statute breach of his contract of service by the workman was punishable by a criminal penalty, and he might be, and indeed often was, sent to prison for such an offence, while, on the other hand, the employer, for an identical offence, was only liable to a civil penalty. This Act was replaced by the Conspiracy and Protection of Property Act, in which not only was this inequality in treatment removed, but a definition of the rights of unions in trade disputes was given, which rendered it impossible for the future that men who organized a strike could be proceeded against under the common law of conspiracy. As this Act now regulates matters between unionists, non-unionists, and masters, a summary of its principal provisions is appended to this article.

"In this way," says Mr. Burnett, from whose valuable Report on Trades Unions, published in 1887, much of our information is gathered, "the trades organizations of Britain have gradually achieved complete emancipation; and there can be no doubt that the freedom which, in this respect, they now enjoy, tends to make them the most contented industrial community in the world."

From the report issued by the Registrar of Friendly Societies for 1886, it appears that there are 252 registered trades unions in England. Of these only 187 furnished returns of the number of their members, amounting together to 278,866. The numbers of the other registered unions are estimated at about 73,000, making altogether a grand total of 352,000. The membership of all trades unions throughout the country may, however, be placed at more than double this figure; no less than 633,038 having been represented at the last Trades Union Conference. In Scotland there are fifteen societies, with a membership of 12,337, a capital of £21,444, and an income of £15,757. In Ireland there are thirty societies, containing 5456 members, having a capital of £3932, and an income of £8859.

Some interesting information concerning the eighteen principal societies which have furnished the necessary particulars will be found in the accompanying table compiled from those of Mr. Burnett in his report already referred to. Their total membership is returned at 194,016, their income for the year at £527,817, and their united capital at £358,489.

STATEMENT OF THE NUMBER OF MEMBERS, AND OTHER PARTICULARS, CONCERNING THE UNDERMENTIONED TRADES UNIONS, AS FAR AS THEY HAVE BEEN ASCERTAINED, FOR THE YEAR 1886.

Societies.	Number of Members.	Percentage receiving benefit as			Contributions per head in the Year.	Amount per head of Membership paid to			Total Income.	Balance at end of Year.
		Unemployed.	Sick.	Superannuated.		Unemployed.	Sick.	Superannuated.		
					£ s. d.	£ s. d.	£ s. d.	s. d.	£	£
Engineers,	52,019	7·4	2·5	2·80	3 4 0¾	1 12 5½	0 11 8½	13 0½	173,937	111,679
Carpenters and Joiners,	24,979	7·8	2·5	0·66	2 17 10¾	1 12 7½	0 13 11¾	2 5¾	76,193	46,725
Steam Engine Makers,	5,079	5·8	2·2	1·70	2 4 10¾	1 2 11	0 10 8¼	5 11½	12,515	9,657
Iron Founders,	12,037	13·9	2·9	3·60	3 8 9½	2 14 7	0 10 4¼	11 11¼	41,877	5,984
Boilermakers and Iron Shipbuilders,	26,776	22·2	3·3	1·00	2 5 5½	1 7 11	0 15 7¼	3 0½	67,839	21,895
Boot and Shoe Rivetters and Finishers,	7,944	—	—	—	—	—	0 7 8½	—	7,571	6,311
Coachmakers,	4,510	—	—	—	—	1 2 11½	0 16 6	14 7	10,023	8,560
Patternmakers,	1,279	9·6	1·5	—	1 14 9¾	1 15 5½	0 6 6¾	—	3,033	1,819
Bricklayers,	6,393	...	—	—	1 8 7	—	0 14 7½	0 4	10,497	24,748
Iron Moulders (Scotland),	5,636	—	—	—	—	2 11 7¾	—	9 3½	19,213	1,737
Compositors (London),	6,585	11·2	—	1·20	1 11 8	0 16 6¼	—	3 3½	13,207	17,607
Journeymen Bookbinders,	910	—	—	—	2 0 4½	1 7 4¼	0 9 5¾	1 0¾	3,469	1,172
Blacksmiths,	2,091	14·4	3·7	0·71	1 15 6¾	1 8 0	0 10 2½	1 10¾	4,004	2,168
Cabinetmakers,	1,052	—	—	—	2 7 8½	1 16 0½	0 6 6¼	—	2,876	876
Operative Cotton-spinners, &c.,	15,527	—	—	—	3 2 8¾	0 18 6¼	—	1 4¼	49,800	35,123
Railway Servants,	9,609	—	—	—	0 19 3¾	0 1 1¾	0 0 4½	—	12,710	55,708
Operative Stone Masons,	10,493	—	—	—	1 6 8½	—	1 10 6¾	7 6½	14,611	4,629
House Decorators and Painters,	1,067	—	—	—	—	—	0 14 4¾	—	1,442	2,091

Some few of the great centralized organizations do not confine their operations to the United Kingdom alone, but extend to other countries. Thus, at the close of 1886, the Amalgamated Society of Carpenters and Joiners had a total of 440 branches, with the following widespread geographical distribution:—In England, 338; Scotland,

15; Ireland, 20; United States, 25; Canada, 6; New Zealand, 10; Australia, 22; and South Africa, 4. The Amalgamated Society of Engineers in 1886 had 432 branches, of which 308 were in England, 42 in Scotland, 14 in Ireland, 13 in Australia, 3 in New Zealand, 1 in the East Indies, 1 in Malta, 7 in Canada, 42 in the United States, and 1 in France.

Unemployed benefit is not paid by all trades societies, but with those of national extent this is generally the chief item of expenditure. The maximum allowance in the year is £19 10*s.* in the Engineers' Society. In no other of which particulars are furnished does it exceed £9 12*s.* In every case the benefit is for a limited number of weeks, and at a decreasing rate. The engagement to provide such a benefit for unemployed members is a very heavy burden on the societies. Numerous precautions are taken against imposition, and rules are made to insure that members out of work shall behave themselves and be ready to accept employment wherever offered. If at a distance the society will pay railway fare, and the member must move as required. Not only is this unemployed benefit a distinct advantage to the men concerned, and a relief to the community at large, but it acts as a powerful means of obtaining situations for men out of work, as the self-interest as well as the fraternal feeling of each member in work induces him to seize every opportunity of finding situations for his less fortunate brethren, and so relieving the funds of his society. When members of a society are out on strike, or have had to leave their employment in resistance to some innovation, the usual unemployed benefit is increased from a special fund called a contingent or dispute fund.

Sick benefit is provided by most of these societies, and ranges from 5*s.* to 10*s.* per week. So also is the allowance for old age, called superannuation benefit, though it varies considerably in amount. In the case of the Amalgamated Society of Engineers, a member who is over fifty-five years of age, and has been twenty-five years in the society, is, if unable longer to follow his trade, entitled to 7*s.* per week. Every additional five years in the society raises the allowance by 1*s.*, until it reaches 10*s.* a week, granted to those who have been members for forty years. This is the highest scale paid by any trade society of importance. Members disabled by accident, loss of eyesight, paralysis, and other causes, are also provided for by a benefit of £100 given in a lump sum. The carpenters and joiners have also a partial disablement benefit of £50, but in the case of the ironfounders the full amount of this benefit is £150. The idea is to enable the member to start in some light business for himself. Upon receipt of this benefit, however, he loses his claim to most of the other benefits.

Funeral benefit is also paid by nearly all trades unions, some of them providing for it on a most liberal scale. The ordinary amount is about £10 to £12. A few societies also provide a fund for assisting the widows of deceased members.

It will thus be seen that the principal modern trades unions are not only organizations for the promotion of trade interests, but that they also afford to the workers a valuable means of thrift, and of self-protection against a train of serious evils which, unless arising from sickness, are not provided against by any of the ordinary benefit societies.

The qualifications for membership generally include good health, sound physique, certain ability as a workman, steady habits, and good moral character; and (except in societies of unskilled labourers) the candidate must have served a regular apprenticeship to his trade. The minimum limit of age for admission to full membership is usually twenty-one years; the maximum varies from thirty-five to fifty years. An entrance fee is generally required, in addition to weekly contributions of 1*s.* per week, with special levies for strikes and other emergencies. By the periodical publication of reports showing the state of trade in various towns and districts some of the unions render valuable service; and another useful plan is that of keeping in each of the larger towns a "vacant book," in which the names of men out of employment and employers in want of men are registered. Some societies also assist men to travel from town to town in search of employment, and, occasionally, to emigrate.

The prime object of these organizations is, however, to obtain better wages, shorter time, or more agreeable conditions of employment. In the skilled trades they insist upon apprenticeship, and seek to regulate the proportion between apprentices and workmen, defending their action on the ground that it is the workman, and not the employer, who instructs the apprentice. In the mining trade, when the output has been in excess of the demand, they have sometimes insisted on diminishing production in order that the price might not fall so low as to entail a reduction of wages. Some unions have endeavoured to fix a limit to the amount of work which each man might do. When payment is by the piece the unions strive to get a recognized price list, and when payment is by time, a scale of wages. In most cases this is intended by them as a minimum only, to set a bar to a gradual reduction of wages. On the other hand, the master treats it as a maximum; he fears if he gives more to one operative, he will be obliged to give more to all. So between the two the result is a uniform wage. But it is the result more than the object. Some unions repudiate uniformity, and allow a man to get more if he can, or take less if he chooses. One of the best results of free association among the workmen of the United Kingdom is the mental culture which it has promoted. Full information upon trade affairs is procured and disseminated; matters are openly discussed; both sides are heard; each member has to decide upon questions, such as strike or no strike, which vitally affect his interests; the minority have to acquiesce, and do acquiesce, in the decision of the majority, however great may be the personal sacrifice entailed by a strike.

The members of trades unions generally believe that wages have been considerably raised through their agency, and they usually assume that this advantage to the workman has been gained by cutting down the profits of the employers. [See WAGES.] Some employers deny that the unions have affected wages at all, while others complain that they have affected them to an injurious degree. On the whole it seems impossible to deny that wages have been greatly advanced, though it does not follow that the increase has been gained by strikes. We must remember that, as Professor Jevons points out ("The State in Relation to Labour," 1882), "many other causes have been in operation tending towards the increase of earnings. Free trade has made the world our customers; invention has proceeded by leaps and bounds; the power of coal has been brought to the assistance of human labour; the capital of employers has grown vastly; the productive powers of machinery have been multiplied time after time." The fact that the general rise of wages admitted by statisticians to have occurred, is by no means confined to trades in which the system of trades unions and strikes prevails, would seem at least to show that the men greatly exaggerate the share which that system has had in the result. In certain cases no doubt a comparatively small body of skilled men, by forming a nearly complete and exclusive society, have been able to limit the supply of skilled labour in their trade and thus artificially raise its price. This constitutes a species of monopoly by means of which a private tax is levied upon the consumers of the goods made by the trade, a state of things obviously injurious to the public interest. The great mistake made by the unions is in assuming that the interests of employers and their workmen are antagon-

istic, instead of identical, or, as Professor Jevons puts it, "Eventually it will be seen that industrial divisions should be perpendicular, not horizontal. The workman's interests should be bound up with those of his employer, and should be pitted in fair competition against those of other workmen and employers. There would then be no arbitrary rates of wages, no organized strikes, no long disputes rendering business uncertain and hazardous. Zeal to produce the best and the cheapest and most abundant goods would take the place of zeal in obstructive organization. The faithful workman would not only receive a share of any additional profits which such zeal creates, but he would become a shareholder on a small scale in the firm, and a participator in the insurance and superannuation benefits which the firm could hold out to him with approximate certainty of solvency." The system of industrial partnerships thus indicated has been applied to manufacturing industry in some few cases in recent years, but with very slight success, though in the herring fishery, whaling adventures, and Cornish mining it has always been usual to make the workman's share depend, partly at least, upon the results.

A trades union congress, composed of delegates from different unions and local federations, has been held annually since 1869. These congresses have as a rule confined their attention to objects which had a direct relation to the interests of the working classes, such as providing for the proper ventilation of mines and reducing the hours of labour for women and children. They have materially contributed towards the adoption of such measures, and the passage of the Labour Laws of 1875 is mainly attributable to the exertions of their committee.

The masters in the principal trades have long had associations for the specific purpose of resisting those of the men. In case of a strike against one of their members they assist him in obtaining other workmen, supply him with funds or credit, undertake or guarantee his contracts, and in other ways help him to dispense with his workmen until they accept his terms.

Strikes hold in the intercourse between employer and employed the same place that war holds with regard to the intercourse of nations. There may be occasions upon which a strike is just and necessary, but the necessity is always a sad one; and any man who aids in commencing a strike, without having by every means in his power attempted to avert it, is guilty of the crime of wantonly bringing misery upon his fellow-workmen, their wives and families, and of injuring the prosperity of his country. The most protracted strikes, with few exceptions, have not been for the purpose of securing an advance of wages, but for resisting a fall. Sometimes a serious strike arises through the workmen's objections to the introduction of a certain class of machinery, to the number of apprentices an employer mig . wish to take, or through the employer refusing to discharge some foreman or some few men to whom the majority have conceived a dislike. In some cases men have consented to forego an increase of wages, and have struck rather to secure a reduction in the hours of labour. In other cases the cause of strikes has been the suspicions of the men that they were not getting fair wages in proportion to the large measure of prosperity attending their trade.

A great many strikes have originated in trades without existing organization, but if a strike assumes any considerable proportions, a governing body is appointed at the time to carry it on. The executive of a large society are more likely to take a cool and moderate view of a question in dispute than the men engaged in the heat of the conflict; and although executive committees are sometimes tempted to keep up agitation beyond what is necessary, in order to increase their importance and show their zeal, experience gradually teaches that the best executive committee is the one which succeeds in accommodating most disputes amicably. Their constituents, each one of whom has to bear as best he may the privations and sufferings which a strike involves, are not likely to long support those who are too ready to plunge them into such a cruel warfare in vain.

The French Tribunals of Commerce furnish some valuable hints for the prevention of strikes. The members of this court are elected under the authority of government, which also determines their numbers by an assembly of merchants, tradesmen, and captains of merchantmen of a certain standing who may be resident within their jurisdiction. The formalities of other courts are dispensed with, and the office of judge is unpaid. The court so constituted takes cognizance of disputes relating to all kinds of engagements regarding trade and commerce. It acts in the first place by way of conciliation only, but this failing, it has power to judge authoritatively, to mulct the litigants in the costs, and enforce its decision. There does not seem any valid reason why some such courts for settling the differences between employers and employed should not be practicable and effectual in this country, as they have been in France, to avert, generally, the extreme resource of a strike. It is very gratifying to observe that, as a voluntary matter, Courts of Conciliation and Arbitration have within the last few years been actually established in a large number of trades and in almost every part of the country.

There are large manufacturing towns, such, for instance, as Nottingham, where strikes are almost entirely avoided by the existence of Courts of Conciliation, composed of both masters and workmen, before which the men can calmly bring their complaints, or masters can make known the reasons for whatever course they may find it necessary to take, and by mutual friendly intercourse all differences are, as a rule, amicably arranged. The Arbitration Court, with its necessary umpire from outside, is only called upon when the Conciliation Court fails to adjust the difference. This, however, is not often the case.

Existing Legislation affecting Trades Unions.—The offences with which the Conspiracy and Protection of Property Act deals are those of conspiracy to do an unlawful act, breach of contract in particular cases involving wilful injury, and the group of offences which come under the general head of intimidation and violence. No combination to effect any act is now punishable as a conspiracy, unless such act, when committed by one person, would be punishable as a crime.

The first specific breaches of contract dealt with are those in the case of gas and water works. Should any person employed in such works break a contract when there is reason to believe that the public will, by such act, be deprived wholly or in part of their supply of gas or water, the offender is liable to a penalty of £20 and three months' imprisonment, with or without hard labour. The same penalties are also involved where a contract of service is broken by any person, with the knowledge that the probable consequences of the breach will be to endanger human life, or to cause serious bodily harm, or to expose valuable property to destruction or serious injury.

Masters also incur the penalty already mentioned if, when liable to provide for their servants or apprentices necessary food, clothing, medical aid, or lodging, they refuse or neglect to do so, whereby the health of their employés is, or may be, injured.

Lastly, the same penalty attends the offences of intimidation, actual violence, rattening, and picketing. There are five distinct heads under which a person may break the law in his anxiety to induce another person to do or abstain from doing that which such other person has a legal right to do, or abstain from doing, as the case may be:—1. To use violence or to intimidate such other person, or his wife or children, or to injure his property.

2. To persistently follow him about from place to place. 3. To hide any tools, clothes, or other property owned or used by him, or to deprive him of them, or to hinder him in the use of them—known as "rattening." 4. To watch or beset the house or other place where he resides, or works, or carries on business, or happens to be, or the approaches thereto—known as "picketing." 5. To follow him, together with two or more persons, in a disorderly manner in or through any street or road—known as "mobbing."

For all these offences, either workmen or employers may be proceeded against summarily; but if a defendant objects to be tried by a court of summary jurisdiction, the offence is thereupon to be considered an indictable one, and the case may be transferred to the sessions and tried by a jury.

The breaches of contract and other offences comprehended by this Act are offences known to the former law as "aggravated," and supposed to be actuated by a wilful and malicious intent. Breaches of contract of an ordinary character, in deference to the susceptibilities of workmen, were dealt with by a separate Act of rather novel form and scope, entitled "An Act to enlarge the powers of County Courts in respect of Disputes between Employers and Workmen, and to give other Courts a limited civil jurisdiction in respect of such disputes," or, shortly, The Employers and Workmen Act, 1875. Breaches of contract, taken by themselves, involve no legal criminality, and workmen were exceedingly desirous that charges of this nature preferred against them should be heard before an exclusively civil tribunal. There were several difficulties in the way of this arrangement, and these were met by giving the general jurisdiction to county courts, and to magistrates a concurrent jurisdiction where the matter in dispute does not exceed £10. County courts may adjust and set off one against the other any claims arising out of the relation of employer and workman, whether for wages, damages, or anything else. They may rescind contracts, apportion wages, award damages, and order securities; and all these matters, up to the value of £10, may be also dealt with by the magistrates, whose court is deemed, for the purpose, a court of civil jurisdiction.

For the purposes of the Act, the expression "workman" does not include a domestic or menial servant, but it does include all labourers, servants in husbandry, journeymen, artificers, handicraftsmen, miners, and any other persons engaged in manual labour, whether above or below twenty-one years of age, who work under a personal contract with their employer, whether expressed or implied, oral or in writing.

The laws with regard to trades unions were further modified and improved by an Act passed in 1876—the 39 & 40 Vict. c. 22—which more clearly and explicitly defines the position of these associations, and extends to them many of the special privileges of friendly societies. Among the most important of these are the power to insure the lives of young children, and to appoint substitutes for absent or incapable trustees, the validity of the membership of minors, the right to nominate to benefits in case of death, and the power of amalgamating with other unions.

TRADESCAN'TIA is a genus of plants of the order of COMMELINACEÆ, which was so named in honour of the English botanist, John Tradescant, who was gardener to Charles I. The species are natives of America and of India. Many of them being of a highly ornamental nature, are cultivated in flower gardens. The Common Spiderwort (*Tradescantia virginica*), a native of North America, is the species most common in the flower borders of English gardens. It is a pretty lily-like plant, from 12 to 18 inches high, with numerous branched jointed succulent stems, linear-lanceolate glossy leaves, and dense umbels of flowers, with three spreading bright-blue petals. Varieties with purple, white, and double flowers are also cultivated. The jointed hairs from the base of the stamens of this species afford one of the best illustrations of the structure of the vegetable cell. Other species are cultivated in gardens and hothouses.

TRADE-WINDS is the term used by seamen to indicate the perpetual or constant winds which, more than any other circumstance, promote trade and navigation. These perpetual or trade-winds occur in all open seas on both sides of the equator, and to the distance of about 30° N. and S. of it. They were unknown to the ancients, and even to modern seamen up to the time of Columbus; but subsequently to that epoch, European navigation extending rapidly in the Atlantic and Indian oceans, the phenomenon was generally observed. It does not, however, appear that any attempt to explain it was made before the time of Galileo, who appears to have had a true, though obscure, perception that the rotary motion of the earth must be somewhat concerned in the production of the trade-winds, but he singularly omitted to consider the operation of the solar heat. The true explanation of the phenomenon was first recorded in the *Philosophical Transactions* for 1735, by George Halley.

The facts respecting the trade-winds, which had been collected by Halley, have not been materially increased in number since his time, but they have been more exactly determined. The mean boundary line of the region in which they blow, and beyond which variable winds prevail is, in the eastern parts of the Atlantic ocean, the twenty-eighth parallel of latitude, both north and south of the equator; but in the western parts this line is generally two or three degrees further north and south. To the north of the equator they blow in the eastern parts of the ocean from the north-east, seldom from the eastward of E.N.E., or from the northward of N.N.E. In proceeding further west they become more easterly, and often they blow from due east, and sometimes from the south of east, but generally they are one or two points north of east. To the south of the equator the trade-winds in the eastern parts of the ocean blow from south-east, and usually between south-east and east, but they also decline more to due east in reaching the western portion of the ocean. They do not occur in the vicinity of the continents, but are chiefly separated from them by a tract of sea, in which either periodical or variable winds prevail. Though the trade-winds of the northern and southern hemisphere blow in an oblique direction towards one another, they do not in general meet, but are divided by a tract of sea, the "doldrums," in which calms frequently prevail, varied by occasional light winds, mostly from the west, but usually oppressive with a thick foggy air and frequent rains of short duration attended by thunder and lightning. The region of calms which separates the north-east trade-winds from the south-east, and which usually occupies a width of four or five degrees of latitude, is not always found at the same part of the ocean, but advances further north when the sun has a northern declination, and further south when it is in the southern hemisphere. The same is observed respecting the winds themselves. Though the mean boundary of the trade-winds is 28° of lat. in the eastern parts of the ocean, it extends two, three, and even four degrees further north when the sun approaches the northern tropic, and about the same distance further southward when the sun is near its greatest southern declination.

The explanation of these phenomena is to be found in the observed fact that the sun is constantly vertical over some one or other part of the earth between the tropics, and that the whole of the zone or belt so included between the tropics is, in consequence of the great altitude attained by the sun in its diurnal course, maintained at a much higher temperature than those regions to the north and south which lie nearer the poles. The heat thus acquired by this tropical

portion of the earth's surface is communicated to the incumbent air, and becomes the universal primary cause of the phenomena of the winds, in conjunction with the earth's rotation. The colder and heavier air glides in on both sides, along the surface, from the regions beyond the tropics; while the displaced air, thus raised above its due level, and unsustained by any lateral pressure, flows over, as it were, and forms an upper current in the contrary direction, or towards the poles; which current being cooled in its course, and also pressed down by the mass of the atmosphere above to supply the deficiency in the extra-tropical regions, thus keeps up a continual circulation—a surface-current from the higher latitudes towards the equator, and an upper current towards the poles. Were the earth then at rest, there would be an unvarying north wind in the northern half of the globe and a south wind in the southern half. In consequence, however, of the rotation of the earth, objects on its surface at the equator are carried round at the rate of 17 miles per minute. The further we recede from the equator the less is this velocity; half-way from the equatorial line to the poles, or in lat. 68°, it is just half, or 8½ miles per minute; and so on until at the poles it is nothing. It follows, then, that when a mass of air near the poles is transferred to the region near the equator, it is constantly arriving at places which have a greater velocity than itself, and is unable to keep up with the speed of the new surface over which it is brought. Hence the currents of air which set in towards the equator from the north and south must, as they glide along the surface, at the same time lag, or hang back, and drag upon it in the direction opposite to the earth's rotation, that is, from east to west. Thus these currents, which but for the rotation would be simply northerly and southerly winds, acquire, from this cause, a relative direction towards the west, and become permanent N.E. and S.E. winds.

It follows from this, then, that as the winds from both sides approach the equator, their easterly tendency must diminish. The lengths of the diurnal circles increase very slowly in the immediate vicinity of the equator, and for several degrees on either side of it hardly change at all. Thus the friction of the surface has more time to act in accelerating the velocity of the air, bringing it towards a state of relative rest, and diminishing thereby the set of the currents from east to west. Arrived, then, at the equator, the trade-winds must be expected to lose their easterly character altogether. And not only this, but the northern and southern currents here meeting and opposing, will mutually destroy each other. The result is the production of two great tropical belts, in the northern of which a constant north-easterly, and in the southern a south-easterly wind prevails, while the wind in the equatorial belt, which separates the two former is comparatively calm, and free from any steady prevalence of easterly character.

With respect to the trade-winds in the Pacific Ocean, we find that in the southern parts they appear to be subject to great changes in direction and force, and that they properly occur only along the coasts of South America, where a south-east wind is always met with at the distance of 500 to 600 miles from the coast. In the middle of the Southern Pacific the current seems by no means regular and constant. Its irregularities are probably produced by the innumerable islands and coral rocks or banks in this ocean between the equator and the southern tropic, and which extend from 130° W. lon. to the coast of Australia, the atmosphere over these banks being less rarefied by the increased evaporation than that over the deep water, and consequently not requiring so great a supply of air to restore the equilibrium as the circumjacent parts, which are more rarefied and heated. It appears that in the Southern Pacific the trade-winds are replaced by the north-eastern, northern, and western winds only during the period when the sun is in the southern hemisphere.

A south-eastern trade-wind prevails also in the Indian Ocean from within a few degrees of the eastern side of Madagascar nearly to the coasts of Australia, between the parallels of 10° and 28° S. lat.; but in this ocean from 10° S. lat. to the coast of Hindustan the winds are periodical. See MONSOONS.

The trade-winds are only met with on the sea; but in some countries of the globe between the tropics, or near them, regular and constant easterly winds occur, which may owe their origin to the same cause. These winds are only observed in extensive level plains, where there is nothing to break their force or change their direction; for if the wind comes in contact with high land or mountains, its regular progress is obstructed. But over a considerable tract of low level land the air passes without being much changed in its direction and velocity, particularly if the land be barren and destitute of moisture. In the Sahel, or the western parts of the Sahara, an eastern wind blows all the year round with great force, but in the eastern district of the Great Desert it is less constant, and not so violent; so that in all respects it may be compared with a trade-wind. An easterly breeze is also found on the plain drained by the Amazons; and by its assistance the voyage against the strong current of the river may be accomplished nearly in the same time as the voyage downwards with the stream. Humboldt found that this easterly wind, which, near the mouth of the Amazons, is moderate, has acquired such a force at the base of the Andes, that it is almost impossible to keep one's footing against it. A similar easterly current, though of less strength, is found in the great plain which is traversed by the lower course of the Orinoco.

TRADI'TION (from the Latin *tradere*) comprises, in the widest sense of the word, all that has been preserved concerning the events of the past, and in this sense all history is tradition. But the different ways in which accounts of past events are transmitted make a difference in the accounts themselves, which are accordingly designated by different terms. In the early ages of mankind and of every nation, when the art of writing was unknown or little used, all events were handed down by oral communication from generation to generation. Afterwards when these were written down and assumed a definite shape, or many shapes, according to the information, the opinions, or the judgment possessed by the person or persons who recorded them, such records would naturally be distinguished from accounts written by eye-witnesses at or soon after the times when the events occurred. Historical criticism distinguishes these two kinds of annals by calling the former tradition, in a narrower sense of the word, and the latter history. The characteristic peculiarity of tradition, in this sense therefore, is that for a time it was transmitted from father to son, or from generation to generation, by oral communication, and was subject to all the influences of such communication, until it became fixed by being put into a written shape. Those who know how, even in our day, reports are changed and embellished, how some features are omitted and others added during the process of passing from mouth to mouth, and how in the end they frequently assume a totally different aspect from what they originally bore, will readily admit that such traditions cannot be received with the same faith as contemporary history. It requires great judgment in an historical writer to handle them. His object should be to discover the genuine story, and to give it simply as he finds it; for thus we have at least a faithful memorial of the manner in which our ancestors conceived and viewed certain things.

In the history of Christianity the term tradition has been applied to the doctrines said to have been communicated by Christ to his apostles, which were not written by them, but were transmitted by their oral instruction to their successors, propagated in the church by the bishops, and

prevented from becoming corrupt, like other traditions, by the influence of the Holy Ghost. These accounts are preserved in the writings of the ecclesiastical fathers, and the Church of Rome regards them next to the Bible as a source of knowledge which ought to regulate the life and religious observance of Christians. Thus the New Testament and tradition go hand in hand, and exercise a mutual influence, by completing and explaining one another. The subject of the tradition revered by the Church of Rome affects, however, rather the forms of religion than its essence; and some of these forms are retained and observed by Protestants, while on the whole they reject tradition, and do not consider it binding.

TRAG'ACANTH. See GUM and ASTRAGALUS.

TRAGEDY. See DRAMA.

TRAG'OPAN (Ceriornis or Tragopan) is a genus of game birds (*GALLINÆ*) belonging to the family Phasianidæ, distinguished by having the head furnished with a crest, the cheeks and a space round the eyes naked, a horn-like caruncle projecting backwards from behind each ear, and a loose wattle hanging beneath the bill. The Tragopans or Horned Pheasants are natives of Eastern Asia. They are stoutly-built birds, with short rounded tails. The males, which are alone furnished with a crest, are remarkable for the beauty of their plumage, but the females are adorned with more sombre hues. The Horned Tragopan (*Ceriornis satyra*) is a native of Nepal, Sikim, and Bhotan, on the slopes of the Himalaya Mountains. It is about the size of a large fowl, and of a deep-red colour, covered with numerous white spots, each within a ring of black. This species is replaced on the North-western Himalayas by the Black-headed Tragopan (*Ceriornis melano-cephala*). Two other species occur in China and Upper Assam.

TRAGU'LIDÆ. See CHEVROTAIN.

TRA'JAN (Marcus Ulpius Nerva Trajanus) was most probably born in A.D. 53, at Italica, the present Alcala del Rio on the Guadalquivir, not far from Seville, in Spain. He distinguished himself at an early age in the wars against the Parthians and the Jews, became consul in A.D. 81, and afterwards commanded the legions on the lower Rhine. His military talents and his amiable character made him popular with the troops; and the Emperor Nerva adopted him in A.D. 97, and chose him for his successor. This was a novel event in Roman history, the imperial throne having hitherto been exclusively occupied by members of the old Roman aristocracy. Trajan was the first emperor born beyond the limits of Italy.

On the death of Nerva, in January, A.D. 98, Trajan succeeded to the imperial throne, and soon proved that he deserved his elevation. He was a man of remarkably fine physique, "every inch a king," of broad and generous views, and of high moral tone, indefatigable in work, sound in judgment, simple in manners. He was adored by his soldiers, all whose fatigues he shared, and marched with them on foot into Rome when journeying thither from Cologne to assume the throne. His virtues and eminent qualities are commemorated in the panegyric that Pliny the Younger read in the senate A.D. 100. In 103 Pliny, who was a personal friend of the emperor, was appointed proconsul of Bithynia and Pontus. The letters that passed between them are the best sources with regard to Trajan's private character.

In A.D. 100 Trajan crossed the Danube to conquer the Daci; and when, in 104, their king Decebalus broke the peace, Trajan again advanced against him. To secure a passage over the Danube, he constructed the great bridge of which Dion Cassius has given a description. Decebalus was defeated, and killed himself, and in 106 Dacia was made a Roman province and colonized by Roman settlers. Though so simple in his personal habits, Trajan knew the value of splendour, and his triumph at Rome was the most splendid then on record. The games lasted 123 days, and involved the slaughter of 10,000 gladiators and a yet larger number of wild beasts. Our horror at such facts must not, however, militate against the character of Trajan, as seen in due historical perspective, for he was a most merciful and even tender-hearted prince.

After the conquest of Dacia eight years of peace elapsed, which Trajan employed in a wise and liberal administration, and in adorning Rome with beautiful buildings; he also completed the magnificent Forum Trajanum, of which a few columns still remain, and founded a library, the Bibliotheca Ulpia, a magnificent theatre, a great road across the Pontine marshes, with bridges, &c., and an institution for the education of poor children of Italian parents. In 114 he left Rome to lead his armies against the Parthians, who were defeated, and in one campaign he conquered Mesopotamia and delivered Armenia. He took up his winter quarters at Antioch, relieved the Syrians, who were suffering from the consequences of a violent earthquake, and in the following year opened a new campaign. He crossed the Tigris, and the Parthians having again been defeated, captured the towns of Misibis, Edessa, Ctesiphon, and Seleukeia; and Babylonia, Assyria, Armenia, and Mesopotamia became Roman provinces. He then sailed with his fleet on the Tigris to the Persian Gulf, and when he had reached the sea, the example of Alexander suggested to him the idea of conquering India; but, remembering his advancing age, he renounced that scheme. In 117 he made an incursion into Arabia, and ordered a fleet to be stationed in the Red Sea. Suffering from dropsy, he set out for Rome; but he died on his way at Selinus, a town in Cilicia, in August, 117, at the age of sixty-three years nine months. He was succeeded by Hadrian. Though not himself distinguished as a literary man, probably from want of time rather than of powers, Trajan was keenly fond of literature, and was a munificent patron of all forms of culture. Tacitus, Pliny, Plutarch, Suetonius, and Epictetus, are some of the most brilliant writers of the age, second only to the splendid era of Augustus in Latin literature.

TRA'JAN'S COLUMN, a distinguished work of art, executed by Apollodôros of Athens, which stood in the centre of Trajan's forum at Rome. It was erected in 114, to commemorate the emperor's victories over the Dacians; and is entirely surrounded with bas-reliefs of his exploits, amounting to about 2000 heads. The figures have very little relief. Those at the bottom of the column are 2 feet high; and those at the top appear almost of the same size, because the artist enlarged his figures in proportion as they approached the summit. The pillar is of white marble; and in the interior is a staircase, which receives its light from forty-four windows. Its height is 144 feet; and its sculptured ornaments are considered superior to those of the Antonine column, which is 35 feet higher.

TRAJEC'TORY, the technical name which was formerly given to a curve. It now designates a curve which enters into all curves of a given system at the same angle. If the angle be a right angle, the curve is said to be an orthogonal trajectory.

TRAMWAYS, STREET. In the cities of northern Italy the practice of laying down smooth tracks of hard marble in the ordinary paving of the streets, which prevails in those cities to the present day, appears to have been applied for many centuries. The object in constructing such roads is, by diminishing the friction, to make a less amount of power adequate either to impel a carriage with greater velocity or to urge forward a greater load.

Modern street tramways, as generally understood, are, however, in reality railways laid at the surface of the roads. They are intended to facilitate the movement of omnibuses or vehicles for the conveyance of passengers, the vehicles having flanged wheels or wheels specially constructed to run upon them, the motive power used being generally that of animals, and not locomotives, as on ordinary railways.

Street tramways exist to a great extent in New York, Chicago, St. Louis, Philadelphia, Boston, and other large towns in the United States; in fact, one of the first things done in America where a population has aggregated to 20,000 or 30,000, is to lay down these railways. In New York and other large towns there are cabs, hackney carriages, and other vehicles for public hire, but they are few in number, expensive, and comparatively little used, whilst all classes of the population use the street tramways constantly and almost exclusively. In Toronto, Montreal, and other towns in Canada, there are similar tramways, and they exist at Valparaiso, Nova Scotia, Paris, St. Petersburg, Vienna, Berlin, Rome, Naples, Brussels, Copenhagen, Hamburg, Geneva, and in fact in almost every large town on the Continent.

It was the misfortune of the promoters of tramways in London to have this system of locomotion associated with George Francis Train—an eccentric American—and the highly objectionable system of tramway he laid in Westminster and in other localities in England in 1861, in which he adopted one of the worst patterns of the obsolete trams that had been used in New York, and which had long been replaced by better forms. Tramways in England date from a much earlier period than Train's public appearance in England. In fact, the word *tramway* is said to be an abbreviation of "Outram-way," a name derived from Benjamin Outram, who made some improvements in the system of railways for common vehicles then in use in the north of England. Mr. Outram was the father of the General Outram of Indian fame. From 1827 till 1839, when the railway was opened to Preston, a tramway was in constant use in that locality, which had, in parts at least, a grooved rail, and was crossed daily by the stage-coaches at Bamber Bridge without accident or inconvenience. In 1830 a scheme of street tramways for Manchester was proposed, but failed to enlist a sufficient degree of support. In 1857 the directors of the London General Omnibus Company, impressed with the success of the tramways of Paris, Lyons, New York, Boston, and other cities, recommended to their shareholders the application of £50,000 to the provision of a tramway from Notting Hill Gate to Fleet Street and the Bank, with numerous branches. The company, however, delayed to proceed with the project, and in 1861 Mr. Train entered the field and laid his lines of tramway under arrangement with the local authorities, but without parliamentary powers. The superiority of his vehicles, and the increased comfort they gave to travellers, were admitted from first to last of the experiment, but the form of rail was radically bad. Practically, it made a groove in the roadway of nearly 5 feet wide and about an inch in depth. Vehicles crossing it were violently jolted; those that attempted to cross it at angles more or less oblique had their wheels "hugged," their axles strained; and numerous and serious accidents resulted from the trams to horses and carriages of all kinds other than tramway cars. Train's lines were consequently cleared away, as nuisances, by a *mandamus* from the Court of Queen's Bench. They were a dangerous obstruction to the ordinary vehicular traffic; and it was not to be borne that a speculating company or firm should appropriate an important part of the public thoroughfares to the serious damage of the community using public or private vehicles. The result was to arouse a strong prejudice against tramways altogether, and to defer the adoption of them for some years. In 1868, however, three Tramway Acts were passed for the metropolis. The wide highways of South London and the broad road from Whitechapel to Bow were the first London thoroughfares on which trams were laid, and the success of the experiment was beyond expectation. The pattern of tram adopted obviated entirely the objections to those of Mr. Train, in that the level of the street is preserved, and vehicles of all kinds may pass over the trams at any angle without difficulty, danger, or risk of damage. The rails are laid level with the road, and only break its surface by a groove so narrow that neither the wheel of an omnibus, cab, phaeton, or even of a baker's handcart can be caught in it. The tramway companies lay their lines and pave the space between them and for 18 inches on each side, and are bound to keep this part of the road in repair as long as their occupation lasts.

The form and description of the tramway rails successfully working in London consist of a flat bar of iron, about 4 inches wide and $1\frac{3}{4}$ inch deep; the upper surface having a groove in it about 1 inch wide and $\frac{3}{4}$ of an inch deep, in which the flanges of the wheels of the carriage run: the rails are secured to wooden sleepers 4 inches wide and 6 inches deep, laid upon a foundation of concrete; the gauge or width between the groove in the rail is the same as the narrow gauge of the railways, viz., 4 feet $8\frac{1}{2}$ inches; the rails are retained at that width by iron chairs and iron bars, acting both as tie and stretching rods between rail and rail, and laid at intervals of about 4 feet 6 inches apart. The paving between and outside the rails is at the same level as the top of the rail. The groove is about 1 inch from the inner side; and this inner space of 1 inch is corrugated on the surface. The outer space from the groove, which is 2 inches wide, is smooth for the wheel to run upon. The tramways are placed in the centre of the road, and with a double line the cars pass each other without difficulty or interruption. The cars are very light, handsome, and commodious vehicles, constructed to carry seventy passengers. Between the seats there is a width of nearly 4 feet, so that it is possible to walk between a double row of passengers without in the least degree inconveniencing them, or to stretch the legs, when seated, after a fashion unknown to the occupants of an omnibus. Each car runs on four wheels, which are contained within its width, and is hung on springs formed of blocks of india-rubber. Access to the roof is obtained by means of a light ladder. The horses are harnessed by collar and traces only to two splinter bars pivoted to a cross piece at the carriage end of a common pole, and this pole is secured to the car by a bolt that is dropped through an opening. When the car arrives at the end of its journey the bolt is lifted, the horses, with their pole and splinter bars, are marched round to the other end and fastened there in the same manner. The terminal platforms are precisely alike, and the cars run either way with equal facility. The driver stands upon the platform that happens to be in front, and at his right hand he has the handle of a break, by which the car can be stopped in its own length. The horses are spared the whole of the painful labour of arresting the motion they have caused; for while he checks them with one hand, the driver applies the break with the other, and the car is stopped immediately. When the street is crowded, and vehicles are crossing and re-crossing, the break is in constant requisition, and is even more important than the reins. The success of the London tramways was so great that they were at once adopted in other large towns, and nearly every place of importance in the United Kingdom is now supplied with them.

It is calculated that the effect of the tramway is to diminish draught to one-third, or to enable one horse to do the work of three; and the advantages possessed by the tramway system over the ordinary street locomotion as regards dead weight may be understood when it is remembered that the common omnibus weighs 25 cwts., and carries twenty-six passengers, or with the conductor and driver twenty-eight persons, or, at fourteen to the ton, 2 tons. The tramway cars weigh 2 tons, and carry seventy persons, including the driver and conductor, or 5 tons of paying weight. Passengers can therefore be carried at a considerably cheaper rate than previously, and at the same time enjoy a very superior amount of comfort, owing to

the quick smooth movement, and the entire absence of shaking and noise.

The strain upon the horses employed to draw the tramway cars is very severe (they are "worn out," on an average, in four years), and therefore several attempts have been made to substitute steam-power, compressed air, and electricity, though as yet they have not been very successful in this country. Cars drawn by steam are quite common in several towns in America, and they are also used in Paris and other towns in Europe; but hitherto the legislature of Great Britain has refused to repeal the provision by which the use of steam on common roads is only permitted between the hours of 10 p.m. and 6 a.m.

TRAMWAYS, WIRE, for carrying weights suspended from a wire rope overhead, are now better worked by electricity than by stationary engines, and the best type of electrical wire-tramways is described under TELPHERAGE.

TRANCE. See CATALEPSY.

TRA'NI, a town in Southern Italy, situated on the coast, 26 miles north-west from Bari in the province of Bari, gives title to an archbishop, and had 25,647 inhabitants in 1882. The civil and criminal courts of appeal for the provinces of Bari and Otranto hold their sittings in Trani. The town is well built, is surrounded by a wall with towers and moats, and is entered by three gates. It has a castle, erected by the Emperor Frederick II.; a handsome cathedral, several other churches and convents, theatre, a harbour for small vessels, and some good quays. The inhabitants carry on a considerable trade in oil, corn, wine, and cotton. There are also some manufactures of the latter. Trani was one of the points of embarkation of the crusaders.

TRANQUEBAR' (*Tarangambadi*), a seaport town in Tanjore District, Madras, with a population of 14,000. In 1612 a Danish East India Company was formed at Copenhagen, and in 1616 the first Danish ship arrived in India. The captain, Rodant Crape, to effect a landing, is said to have wrecked his ship off Tranquebar, at the expense, however, of his crew, who were all murdered. He then contrived to make his way to the Raja of Tanjore, and obtained for the company Tranquebar, with land around 5 miles long and 3 miles broad. A fort was built; and in 1624 Tranquebar became the property of the King of Denmark, to whom the company owed money. For supplying arms to the Nawab of Arcot, Haidar Ali, in 1780, exacted a fine of £14,000 from the Danes. Tranquebar was taken by the English in 1807, with other Danish settlements in India, but restored in 1814. It was bought by the English from Denmark in 1845, at the same time as Serampur, for a sum of £20,000.

In Danish times, Tranquebar was a busy port, and contained a number of Danish families, many of which left the place when it became an English possession. Under English rule the revenue increased rapidly; and as the port affords better anchorage than Negapatam (Nagapattanan), it soon drew away the trade of the latter place. However, the construction of the South Indian Railway, which was completed from Negapatam to Tanjore in 1861, and to Trichinopoli in 1862, restored the trade to Negapatam; and Tranquebar has since very much decayed.

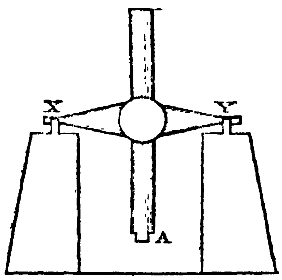
TRANSCENDEN'TAL (Lat. *transcendere*, to go beyond). In the scholastic philosophy, *transcendentalis* designated anything that was not *prædicamentalis*, that is, anything that rose above, was not comprehended in and could not be defined by, either of the ten categories of Aristotle. Thus, being was transcendental, and only some category of being was prædicamental. Kant gave new and distinct significations to transcendent and transcendental. The former designated what is wholly beyond experience, and thus lies beyond every category of thought. The latter designated *a priori* conceptions and judgments, which are necessary and universal, and which transcend the sphere, while affording the conditions, of the contingent knowledge furnished by experience. Thus by the transcendental, formal, or critical philosophy of Kant is meant his system of the principles of the pure reason, which occupies itself not with the objects or matter of knowledge, but with the subjective ideas or forms, as time, space, substance, and causality, through which objects are represented to us as phenomena. Objects in themselves (*Dinge an sich*) he deemed, on the other hand, transcendent.

In mathematics, transcendental quantities are those which cannot be expressed by a finite number of algebraic terms, but are represented by means either of logarithms, or variable exponents, or some of the trigonometrical functions. Transcendental curves, as the logarithmic spiral, are those whose equation is transcendental, *i.e.* expresses a relation between transcendental quantities.

TRAN'SEPT, that part of a cruciform church which is placed between the nave and choir, and extends beyond their side walls, forming the short arms of the cross upon which the plan is laid out. Several English cathedrals have two transepts, as Salisbury, York, Canterbury, Lincoln, Rochester, &c.

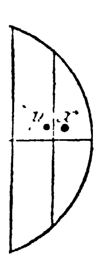
TRAN'SIT INSTRUMENT. We refer to TELESCOPE for an account of the optical principles involved. We shall here refer to the method in which the telescope is mounted so as to form a transit instrument. An ordinary telescope, A B (fig. 1), is fixed to an axis at right angles

Fig. 1.



to the telescope. The shape of the axis and the mode of attachment of the telescope thereto are specially designed so as to secure as much rigidity as possible. At the extremities of the axis are pivots, X Y, which revolve in bearings supported on solid piers. Thus the transit instrument can be moved only in one plane.

Fig. 2.



In the focus of the object-glass, close to the eye end of the telescope at A, a number of fine lines, usually spiders' webs, are stretched (fig. 2). These are placed at equal distances apart, and perpendicular to the axis around which the telescope revolves. When the telescope is pointed to a star the image of the star is formed in the same plane as the spiders' lines, and as the star moves by the diurnal motion

from x to y, the image of the star is seen to pass across each of the lines in succession. The time is noted by the sidereal clock, and the mean of the times is adopted as the clock time when the star passes the meridian. Three adjustments are necessary in order that the indications of the transit instrument shall be correct. We must have the axis of the instrument rigidly perpendicular to the line of the pivots; the pivots must themselves point due east and due west, while the plane in which the axis of the telescope revolves must pass through the poles of the heavens. For an account of the mode in which these adjustments are to be made, and of the methods by which the observations are to be corrected so as to free them from the effects of imperfect adjustment, reference must be made to works on practical astronomy.

The transit observer in large observatories now generally uses the galvanic method of recording his observations by the instrument known as the chronograph. The sidereal clock transmits a momentary current every second, which acts on a pen and produces a dot on a revolving drum of paper. The pen is also under the control of the observer, who causes a dot to be made as the star passes each wire. By comparison of these two systems of dots it is possible to determine the moment when the star crossed the central

Fig. 3.

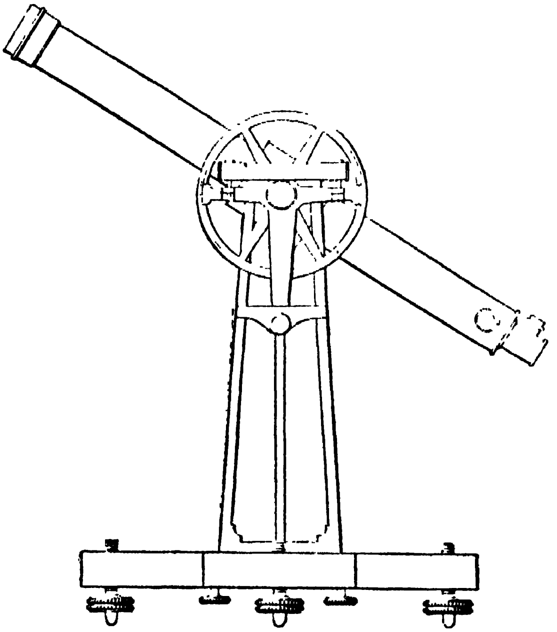
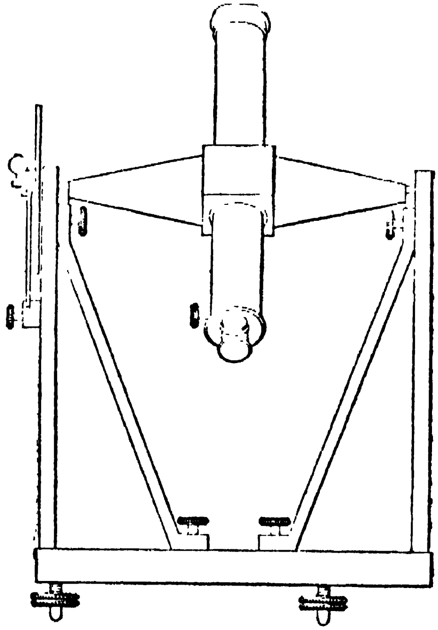


Fig. 4.



wire with great precision. This method of observing, besides being more accurate, preserves a faithful record of the work, and also enables work to be done more rapidly. The old eye-and-ear method is therefore now practically superseded in all observatories of importance. Figs. 3 and 4 show a portable form of transit instrument, in which three levelling screws and sensitive spirit levels are provided for adjustment. See MURAL CIRCLE.

TRANSITS OF MERCURY AND OF VENUS. See MERCURY and VENUS.

TRANSLATION, MOTION OF. This word is used in mechanics, as distinguished from *Rotation*, in the following manner:—A body has motion of translation when all its points move in parallel lines; when, in fact, all its points have the same motion. If all have not the same motion, there is either simple rotation about an axis, or a compound of translation and rotation. The motion of a single point must always be called translation, rotation being an inadmissible idea.

TRANSMIGRATION OF SOULS. The belief that man is a twofold being consisting of body and soul, and that the latter is capable of a separate and independent existence is common to most nations of the earth, civilized and uncivilized, and its origin is far too remote to be traced at the present stage of human knowledge. Wherever it has been entertained, however, the belief has naturally brought with it certain questions concerning the origin and destiny of the soul, to which no positive or demonstrative answer can be found, but which have afforded scope for much imagination, and for speculative answers of the most divergent character. One of the oldest and one of the most widely spread of the doctrines relating to the soul, is that which regards it as migrating through different bodies, entering them at birth and resuming its travels at death, such doctrine being commonly termed the doctrine of transmigration. By the ancient Egyptians it was maintained that the earthly life of man represented a disciplinary stage of existence, through which the soul had to pass on account of transgression; and further, that after death it passed to the judgment-seat of the gods, from whence, if pure, it passed on through higher stages of existence; but if impure, it was returned again to the earth, to be born again as a human being, animal, or plant. Among the Greeks the doctrine seems never to have become part of the popular belief, but it was taught secretly in some of the mysteries, and it was accepted and expounded by several of the philosophers, including, according to some authorities, Thales and Pherecydes, as well as Pythagoras, while in a modified form it obtained a prominent place in the system of Plato. In India the belief in the transmigration of the soul was at an early period accepted as an essential doctrine of BRAHMANISM, and, as we have noticed elsewhere, it had become such a necessary idea in all religious speculation, that it passed without question, though

with most important modifications, into the system of BUDDHISM. Forming as it does an essential tenet of these two widely spread religions, it will be evident that it is part of the religious belief of a very large section of the human race.

In Judaism and Christianity the doctrine has never obtained general acceptance, or been accounted orthodox; but at different periods it has been taught as an esoteric doctrine by individuals, while it formed one of the beliefs of the Manichæans, and is an essential portion of the mystical system of the KABBALAH.

Among rude and primitive races the belief is very common and widespread, and it has been found prevailing among races so widely separated in every respect as to utterly negative any other theory than that of independent origin. In the ancient philosophies, and in the religious systems of Brahmanism and Buddhism, the notion of transmigration is associated with ethical ideas, and the condition of the soul in its different lives is believed to depend upon its conduct; but among negroes, Indians, and other uncivilized peoples, the transition from one body to another is regarded as a matter of chance, and beyond removing some of the natural dread of death, the belief does not appear to have much influence upon conduct.

Somewhat recently the doctrine has been revived in India, England, and America, along with a farrago of nonsense designated "theosophy or esoteric Buddhism," invented by certain professional members of the now nearly moribund system of spiritualism; but as presented by them the doctrine loses all the interest which is attached to it, when we meet with it as a sincere and simple religious belief, or the earnest thought of a philosopher striving in vain to penetrate the mystery which encircles the existence of man.

TRANSMUTA'TION, in alchemy, the pretended operation of changing what were called the imperfect metals, as lead, copper, tin, into the two precious metals, gold and silver.

TRAN'SOM (Lat. *trans*, athwart), in architecture, the horizontal piece framed athwart a double-light window, as distinct from the vertical divisions or *mullions*.

TRANSPIRA'TION, in botany, is the term used for the exhalation of watery vapour from the general surface of the plant exposed to the air. Transpiration takes place in general through the STOMATA of the leaves, but the watery vapour is sometimes exhaled directly through the leaves where the cuticle is very thin. The object of transpiration is to get rid of the excess of water absorbed by the roots, since nitrogenous matter can only be taken up by the root hairs in a very dilute solution. It attains its maximum when light and heat are greatest; hence, the drier the air and the higher the temperature, the greater will be the amount of water transpired. But the amount is also governed to some extent by circumstances connected with the plant itself, such as the number and size of the stomata and of the intercellular spaces beneath them. Transpiration is greater, as a rule, from young than from old leaves, and from evergreen trees than from those with deciduous leaves. The exhalation of water through the leaves in this way causes the sap to ascend in a rapid current through the wood of the tree. See SAP.

TRANSPLANTING. See PLANTING and ARBORICULTURE.

TRANSPORTA'TION. See PRISONS AND PRISON DISCIPLINE.

TRANSPOSI'TION, the name given in algebra to the process of removing a term from one side of an equation to another, changing its sign. Thus

$$\text{if } a = b + c, \text{ then by transposition } a - c = b.$$

Another way of putting it is to say, "take c from both sides;" and it may be doubted whether it would not be better to follow the continental writers in the use of the latter form of expression, a process which would have the advantage of being an appeal to reason instead of rule.

TRANSPOSI'TION, in music, is a change from the original key to one higher or lower. This is generally performed at a moment's notice by a skilful accompanist.

Transpositeur is the name given to an apparatus consisting of a small shifting keyboard, which may, when required, be placed above the true keyboard of a pianoforte, and which is movable to the right or the left, so that playing on the transpositeur the notes as written, really produces the music in another key, and so obviates the frequent difficulties attending transposition at sight. The same object is attained by shifting the whole keyboard of a pianoforte ("transposing pianoforte"); but this is a more expensive, less durable, and in all ways a comparatively inefficient way.

TRAN'SUBSTANTIA'TION. See REAL PRESENCE.

TRANSVAAL, THE, or **THE SOUTH AFRICAN REPUBLIC,** is a large territory of South-east Africa. It is quite inland, its eastern boundary being 100 miles from the sea-coast of Delagoa Bay. Its southern boundary is formed by the Vaal River On its north side, beyond the Limpopo River, the Transvaal borders on the vast wilderness of the interior of Africa. It is bounded on the east by the mountains, a continuation of the Drakenberg, and on the west by the country of the Bechuanas and the Kalahari Desert. The greatest length, north to south, is 500 miles, and greatest breadth about 375 miles, presenting an area of 114,360 square miles. The white population, of European race, in 1884 was 50,000, while the natives were estimated at 700,000. The whites are chiefly Boers or immigrant farmers and the descendants of Dutch colonists, the Dutch language being in common use in the country and English in the larger towns.

Physical Features.—The country generally is a high pastoral plateau land, averaging about 3000 feet in elevation above the sea, supported on the east by the high range of the Drakenberg, and extending westward to the interior desert region of the Kalahari. Within it two ranges of hills of inconsiderable altitude extend from west to north-east across the country; they are the southern Magalies or Kashan Mountains, which form the southern edge of a broad plateau filling the south of the country, and named the Hooge Veldt (or high field); and the chain of detached ranges named the Marikele or Waterberg, Hangklip, Makapans, &c., joining with the Drakenberg on the north-east. These divide the country into three zones: (1) that of the High Veldt in the south, a region extending over about 35,000 square miles, most of it grazing country, at an elevation of from 3000 to 8000 feet, with bracing climate, well watered generally, but very dry in winter; (2) the Middle Veldt, occupying about 25,000 square miles of broken country with wooded gulleys and tracts which offer great facilities for cereal cultivation; (3) the Low Veldt, or Bush Country, occupying the northern region of the Transvaal, generally from 2000 to 4000 feet above the sea, covered with mimosa groves and thorn thickets, subtropical in climate.

The two chief rivers are the Ky Gariep, or Vaal River, a main tributary of the Orange on the south, and the Crocodile or Limpopo (also called Oorie, Bempe, Nuti, or Inhampoora), on the north, the one flowing south-westward, the other, gathering its headwaters in the Magalies range, and coursing round north, east, and south-east, to reach the Indian Ocean north of Delagoa Bay. The Olifant River, which rises in the same range as the Limpopo, is its largest tributary. Neither of these rivers or their tributaries are at all available for navigation; during the rainy season they gain considerable depth, but in the dry, their banks, shallows, and rapids render them useless.

Climate.—The Transvaal reaches northward well into the tropical region, and would have a subtropical climate were it not for its general elevation above the sea-level, which gives it a mild temperature over the southern two-thirds of its area, well suited to Europeans. In the Limpopo valley on the north fevers are prevalent. The rainy season begins in September or October, and showers fall at intervals all through the summer months till March or April. The winter is the dry season.

Products and Industries.—Pastoral pursuits are the characteristics of the country; sheep, horned cattle, goats, and pigs thrive well in most districts, but horses require to be removed to the higher hills in summer, as they are very liable to disease here, as in other parts of South Africa. In some parts of the middle and northern bush country the *tse-tse* fly is a scourge, its bite being almost invariably fatal to cattle and horses, though it is not dangerous to man. A horse which has been bitten and has recovered is termed "salted," and is very valuable. Wild animalsi are very numerous, though hunting has done much to drive these towards the inner and northern borders of the Transvaal; there lions, elephants, buffaloes, giraffes, and ostriches are still found, and over the colony all kinds of antelopes, spring-bok, wildebeese, zebra, and quagga are numerous. Wheat and oats yield heavy crops on the cultivated parts of the High Veldt; fruit trees, sugar, and coffee thrive in the north.

The country is becoming celebrated for its mineral wealth; gold, silver, diamonds, iron, copper, lead, cobalt, sulphur, saltpetre, and coal being known. Gold is specially abundant in the northern regions. Coal seems to reach all across the southern portion of the country north of the Vaal River. Warm springs and limestone caverns on the High Veldt are natural curiosities. There are well-marked but rough waggon tracks throughout the country. At present most of the external traffic with the Transvaal passes by way of Natal over the difficult Drakenberg range. The chief town and seat of government is Pretoria.

The Transvaal was founded by descendants of the large body of thriving and industrious Dutch farmers who first founded Cape Colony. From the latter colony, and subsequently from Natal, the Dutch settlers retired on the introduction of the British government. Natal was proclaimed British territory in 1843, and the Boers resolved upon their second exodus. Some went to the Orange Free State, and others spread over the Transvaal, or the land stretching from the Vaal to the Limpopo, where a government was formed, the laws of the old Dutch colony at the Cape were revived, and large areas were selected for farms. By the Sand River Convention in 1852 the British government recognized the complete independence of the Transvaal, thereafter known as the South African Republic, which was a curious union of communism and oligarchy, the executive pov being in the Volksraad, or assembly of the people. Difficulties having arisen between the natives and the Boers which endangered the whole European population of South Africa, in 1877 the Transvaal was annexed by the British government, and an administrator with an executive council and legislative assembly appointed. In December, 1880, the Boers took up arms against the British government, and as a result a treaty of peace was signed in 1881, and a commission appointed to define the relations between Great Britain and the Transvaal. According to the agreement thus made self-government was restored to the Transvaal so far as regards internal affairs, the control and management of external affairs being reserved to her Majesty as suzerain. A British resident was appointed, with functions analogous to a consul-general and chargé d'affaires. A further convention was signed in London in 1884, by which the state is known as the South African Republic, and the British suzerainty was considerably restricted.

TRANSYLVA'NIA, a crown-land of the Austrian Empire, bounded N. and W. by Hungary, E. by the Bukowina and Moldavia, and S. by Roumania. Its greatest length from N.W. to S.E. is 194 miles, and its greatest breadth from W. to E. is 184 miles. The Germans call it *Siebenburgen*, the Hungarians *Erdely Orzag* (woody country). The Latin name Transylvania was given to it by the Hungarians, from the circumstance that extensive woody mountains separate it from Hungary. The eastern and southern boundaries are formed by the Carpathian Mountains, the passes of which are of great military importance, being the only means of communication between Transylvania on one side and Roumania on the other. Some of them are exceedingly narrow, and are cut through the solid rock for more than 30 miles. Many of them have been the scene of most desperate conflicts with the Turks.

The surface of the country is very much diversified, but s generally mountainous: the Carpathian chain not only covering its south and east frontier, but sending out numerous ramifications, the most important of which proceed from east to west. The culminating points of the mountains are situated near the south frontier, where Negoi, not far from Hermannstadt, has a height exceeding 8000 feet; and Butschetsch, near Cronstadt, is scarcely 100 feet lower. Many of the summits present scenery remarkable for its grandeur. Extensive tracts of hilly and mountainous parts are covered with forests, which yield abundance of magnificent timber. There are no plains of importance, but the valleys are numerous and very picturesque. The lowest part of the country is more than 500 feet above the level of the sea.

All the important rivers are tributaries of the Danube, either flowing directly into that river, or joining the Theiss. The Maros rises on the eastern frontier at the foot of Mount Tatarrhago. It runs, with many windings and a general westerly course, and has a length of about 400 miles, 190 of which are in Transylvania. The Szamos is formed by the junction of the Great and Little Szamos. The former rises in the north-east of Transylvania, running south-west to Deez, where it is joined by the latter, flowing north-east past Clausenburg from the western frontier. The Szamos joins the Theiss at the village of Apata. The whole length of the Szamos is upwards of 200 miles, and three-fourths of its course are in Transylvania. The Alt, or Aluta, rises a little east of the source of the Maros to the south of Mount Tatarrhago; it has a course of about 250 miles, 134 of which are in Transylvania. There are some important lakes in Transylvania; that of Hados is 15 miles long; St. Anna is 10 miles long and as many broad; Piritsch, in the Carpathians, is renowned for the gas which is exhaled from its surface, and which suffocates birds that fly over it; and the Holt-Maros is a lake formed by the Maros near Karlsburg.

The summer days are very hot, especially in the valleys and in the western and southern parts of the country, but the nights are cold, and in the winter the cold is almost insupportable. In the east the temperature is wet and cold, and not favourable for grain. Cold winds prevail in the spring and autumn, and blow with great regularity. Dreadful storms, followed by sudden severe cold, are frequent, but the rainfall is very low. On the whole, however, the climate is considered healthy, and is more equable than that of Hungary, the mountain chain along the southern frontier keeping off the hot winds.

In the valleys of the south and west the soil is of great fertility; the eastern and northern parts and a tract along the western frontier are covered with forests, where the soil is stony in many districts; but even the stony surface is covered with a layer of mould which renders it very suitable for the cultivation of the vine. The most important mineral is rock-salt, a bed of which extends from

Wallachia through Transylvania to Galicia, covering a space of 570 miles in length, and from 60 to 80 miles in breadth. There are also numerous salt springs. The other mineral products are gold, silver, iron, lead, copper, antimony, arsenic, mercury, alum, sulphur, nitre, and marble. More than twenty gold mines are worked, and nearly every stream in the country is auriferous. Coal and peat abound, but they have not been used for fuel in consequence of the plentiful supply of wood. Various kinds of precious stones are found in the mountains and rivers. The mineral waters are celebrated. Besides enormous quantities of timber, Transylvania produces wheat, barley, corn, oats, millet, and maize; apples, pears, and other fruits in abundance; and good tobacco, especially in the valley of the Alt. The breeding of cattle chiefly occupies the Wallachians; sheep are numerous, and large quantities of hogs are fed in the forests. Fish, wild and tame fowl, and game of all sorts abound; wolves are frequent in the Carpathians, and even bears and lynxes are occasionally met with. The horses are small, but swift, and very suitable for light cavalry. Buffaloes are used for field labour. Manufactures scarcely exist, except in the valley of the Alt, where the Germans produce some fine dyed cloths and cotton, felt hats, leather, and linen. The commerce with Wallachia, Moldavia, and Turkey, is of some importance.

The area of Transylvania is 21,215 square miles, and the population in 1880 was 2,084,048, consisting mainly of Magyars, once the politically dominant class; German colonists, established for centuries in the country, who take the lead in industry, commerce, and general civilization; and Roumans or Wallachs, the strongest in numbers, but very ignorant and abject, as the consequence of ages of ill-treatment. But no country in the world has, within so small a compass, so great a variety among its inhabitants, comprising fourteen distinct races. The different sects are supported by the state, and enjoy equal privileges.

The Austrian government has the greatest possible difficulty, in consequence of the different nationalities of the inhabitants, and the feeling of jealousy they often entertain towards each other. The Wallachs, who have for centuries been kept almost in the position of serfs, are gradually obtaining more influence and importance; and the Saxon or German element, which was so long the dominant one, is declining.

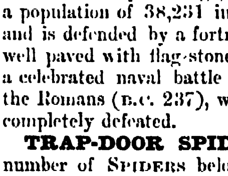
TRAP (Swed. *trappa*, a stair), a now obsolete term, applied by the older geologists to the different kinds of volcanic rock found interstratified with sedimentary formations. The name originated in the circumstance that where such interstratifications occur among the sedimentary strata in hilly regions, the slopes often exhibit a terraced or stair-like appearance, owing to the superior hardness of the igneous beds, which have resisted denudation to a greater extent than the shales and sandstones.

TRA'PA, a genus of plants belonging to the order ONAGRARIEÆ. The flowers have a four-parted calyx, four petals, four stamens, and a two-celled ovary. The fruit is a one-celled nut, with two or four conspicuous horns formed by the hardened lobes of the calyx; it contains a solitary large pendulous seed with very unequal cotyledons. From the resemblance of this singular fruit to the spiked iron instruments called caltrops, which it was the custom formerly in warfare to strew on the ground to impede the progress of cavalry, the common species has been called the Water Caltrops. These plants are found floating on the surface of lakes, and on that of slow-running streams, in the temperate parts of Europe and of Siberia, in Cashmere, India, Cochin-China, and China. They have long jointed root-stocks with tufts of hair-like roots at the joints, and a cluster of triangular-toothed leaves, the stalks of which are swollen and serve as floats. These small plants are of much more importance than many which are more conspicuous or better known, from the fact that their large seeds consist of pure edible fecula. *Trapa natans*, the European species, is remarkable for its fruit with four spines, being of a blackish colour and large size, and its seed, which nearly fills it, being farinaceous, and good to eat, whether raw, roasted, or in soups. It is somewhat like a chestnut in taste. It was known to the Romans by the name of *Tribulus*. In some parts of Southern Europe it is ground into flour and made into bread. The Indian and Chinese species have each only two spines. The former is the *Trapa bispinosa*. In India the nuts are sold in all the bazaars, as their farinaceous kernels are much esteemed by the Hindus. This species, called *Singara*, forms a considerable portion of the food of the inhabitants of Cashmere. The Chinese *Trapa bicornis* is carefully cultivated in lakes, ponds, and other receptacles of water, and its seeds are used as food.

TRAPA'NI, a town on the N.W. coast of Sicily, 46 miles W. of Palermo, is built on the site of the ancient *Drepanum*, on a point of land projecting into the sea, and facing the island of Levanzo, which is 10 miles W. of it. Drepanum was a place of traffic from the oldest times on record; there are, however, no remains of antiquity now extant. Trapani is one of the principal ports of Sicily; it carries on a considerable trade in salt, made by evaporation from sea water, tunny fish, coral fished up along the coast of Barbary and worked in the town, anchovies, sulphur, sumach, wine, gems, and alabaster. The town contains a collegiate church, numerous other churches (some of which contain fine paintings), many convents, several palaces built in a quaint mediæval style, a theatre, a handsome town-hall, a royal college, an orphan asylum, hospitals, and a population of 38,231 in 1882. It is inclosed by walls, and is defended by a fortress. The streets are wide and well paved with flag-stones. Drepanum was the scene of a celebrated naval battle between the Carthaginians and the Romans (B.C. 237), when the latter were signally and completely defeated.

TRAP-DOOR SPIDER is the name given to a number of SPIDERS belonging to the family Mygalidæ, from their habit of closing their burrows with a close fitting lid. These burrows are excavated in the ground in the form of tubes lined with silk. The trap-door consists of particles of earth held together with layers of silk, and is attached by a regular hinge of silk. These spiders are natives chiefly of the Old World. They are roving spiders, coming forth at night in search of their prey. *Cteniza ionica* is found in Greece, its nest being situated often at the roots of olive trees in an elevated situation. The trap-door has an elevated ridge just above the hinge, giving additional weight to the door, and acting as a lever, so that the slightest pressure from within raises it. *Cteniza fodiens* is another species common in South Europe.

TRAPE'ZIUM (Gr. *trapezion*, a little table) is properly synonymous with *quadrilateral*. The term trape-



Trapezium. Trapezoid.

zium is generally, however, restricted to quadrilaterals whose sides are not parallel.

TRAP'EZOID, a plane quadrilateral which has two of its sides parallel

TRAP'PISTS, THE, a religious order, remarkable for the austerity of its practices, was founded at La Trappe in Normandy, about the middle of the twelfth century. The abbey belonged to the Cistercian monks, but having fallen into much laxity of discipline was remodelled on a rigid system by a certain Count de Perche. In the course of years, however, this rigidity almost disappeared, and there was assuredly little of it remaining when the abbey, about 1662, was conferred upon the celebrated Armand Jean le Bouthelier de Rancé, a man of courage, wit, ability, and unbridled profligacy, who was suddenly converted to a Christian life by the death, under appalling circumstances, of a favourite mistress. He set himself to work, with all the energy of his character, to reform La Trappe, and instituted a disciplinary system therein of the severest character. Over every obstacle thrown in his way by the monks themselves or by others his strong will triumphed, and he proved his sincerity by entering anew as a novice in 1663. In the following year he solemnly took the usual vows, and was reinstalled as abbot. Thenceforward he ruled with a despotic crozier. He forbade his monks the use of meat, wine, eggs, fish; enjoined upon them perpetual silence except in cases of necessity (the only salutation when they meet each other is *Memento mori*, Remember death); revived the old monastic custom of manual labour, and completely cut them off from all intercourse with the outer world. The day began at two a.m. with matins in the church, lasting till half-past three; then followed a brief period of private devotion; after which at five, the office of prime, and a lecture. At seven each monk addressed himself to his allotted secular task, returning to the choir at nine for the successive offices of terce, sext, and nine; dining at their close upon a simple dish of vegetables dressed in oil or butter, with a little fruit. Manual labour again occupied a couple of hours, and the monks next devoted an hour to private prayer or reading, each in his own bare solitary cell. At four p.m. vespers were performed in the choir. A brief pause of repose, a supper of bread and water, a lecture, complins in the choir at six, and half an hour of private meditation brought the day to a close at eight o'clock. Then the Trappist betook himself to his hard straw mattress, and sought what sleep he could: sleep being often denied, we fear, to a body insufficiently nourished and a mind constantly overwrought. The Trappists never undress—not even in case of sickness.

During the life of De Rancé the Trappists flourished, and he himself was worshipped by the superstitious, while the sagacious man of the world could not withhold from him his respect. At the Revolution the brotherhood was dispersed, but many of its members found an asylum and a resting-place at Valsanite, in the Swiss canton of Freiburg. Thence they were driven by the storms of war to Augsburg, to Munich, and finally to Lithuania, while small communities were planted in England, Italy, Spain, and other countries. In 1816 they re-purchased their old monastery. They have several small colonies in France, Germany, Ireland, and North America. Their influence now, however, is inconsiderable.

TRASIME'NE. See THRASYMENE.

TRASS is the provincial term for an extensive deposit of old volcanic ash in Northern Germany. It is of the same mineral character as the PUZZUOLANA of Italy, and is similarly used for hydraulic cement.

TRAV'ANCORE (*Tiruvánkodu* or *Tiruvidánkodu*), a native state in the Madras Presidency, is bounded on the north by the native state of Cochin; on the east by the British Districts of Madura and Tinnevelli; on the south and west by the Indian Ocean. The extreme length, from north to south, is 174 miles, its extreme breadth 75 miles, and the area 6730 square miles. The state is in subsidiary alliance with the British government, to which it pays a tribute of £80,000 a year.

Travancore is one of the most picturesque portions of Southern India. The mountains which separate it on the east from the British districts on the Coromandel coast, and which at some points rise to an elevation of about 8000 feet above the sea, are clothed with magnificent primeval forest; while the belt of flat country, to an average distance of about 10 miles inland from the sea, is covered with an almost unbroken mass of cocoa-nut and areca palms, which, in a great measure, constitute the wealth of the country. The whole surface is undulating, and presents a series of hills and valleys, traversed from east to west by many rivers, the floods of which, arrested by the peculiar action of the Arabian Sea on the coast, spread themselves out into numerous lakes or lagoons, connected here and there by artificial canals, and forming an inland line of smooth water communication which extends nearly the whole length of the coast, and is of the utmost value when the sea itself is closed for navigation during the monsoon.

In the hill region the mountains are of every variety of elevation, climate, and vegetation. Some tracts are even now considered inaccessible, and very little has been accurately surveyed. Certain portions have been made over to European and native capitalists, by whom the natural fertility of the soil is being turned to the best account; and every year the area cultivated and the export of coffee increase. Some of the loftier mountains are entirely detached, except near their bases, from the neighbouring heights; they often have a precipitous descent towards the west, and are connected on that side with a succession of low hills, which diminish in altitude as they approach the coast.

The lower hills contain much teak, *pun* (*Sterculia fœtida*), jack (*Artocarpus hirsutus*), black wood (*Dalbergia latifolia*), ebony, palmyra (*Borassus*), and other valuable trees. Gamboge, gall nuts, honey, wax, ivory, cardamoms, and pepper are among the numerous forest products. The finest teak is found in the Cardamom Hills, but except near the Periyar and other large streams it cannot be brought down from the higher ranges to the coast. Pasture is plentiful on the lower slopes, and some of the hillmen herd cattle.

The mountains and vast forests of Travancore afford some of the best sport in India, especially for those who care only for "large game." Elephants, whose ivory is a source of state revenue, are very numerous. Tigers, leopards (including the black variety), bears, bison, *sámbhar* or elk, *nilgái*, and various kinds of deer abound.

Rice and the cocoa-nut palm are the chief sources of agricultural wealth. Next comes pepper, the vine of which grows round the stems of the jack and other trees. The areca nut palm is also very valuable; while the jack-tree is the mainstay of the poor, its fruit being used largely as food, and its timber for house-building. The rice produced is not of the finer varieties, except in Nanganad, and is not sufficient to meet local consumption. In the hills, the cardamom grows spontaneously in the deep shade of the forest; it resembles somewhat the turmeric or ginger plant, but grows to a height of 6 to 10 feet, and throws out at the roots the long shoots which bear the cardamom pods.

Buffaloes and bullocks are used for ploughing, but the latter do not thrive, and indeed the domestic and agricultural animals of Travancore are inferior and ill-trained. Fowls, ducks, and turkeys are plentiful and cheap.

The population of Travancore is 2,350,000, of whom 470,000 are Christians. More than half (63 per cent.) are "Syrians," part Roman Catholics of the Syrian rite, and the rest Nestorians; Roman Catholics of the Latin rite are 21 per cent., and the remainder Protestants. The large Christian population is a distinctive feature of the country. The Syrian Christians date from the earliest

centuries of our era; the Roman Catholics of the Latin rite are the results of the European missions of the Jesuits and Carmelites during the last 300 years.

TRAVELLER'S-TREE (*Urania speciosa* or *Ravenala madagascariensis*) is a noble palm-like tree, belonging to the tribe Museæ, order SCITAMINEÆ. [See MUSA.] It is a native of Madagascar. The leaves are arranged in two rows on opposite sides of the stem, and are of gigantic size, the stalk being from 6 to 8 feet and the blade from 4 to 6 feet in length. The flowers are small in comparison, and are collected in the axils of the leaves. The stalks of the leaves are remarkable for containing, even in the driest weather, a large quantity of water, which flows readily if the stalk is pierced, and is pure and agreeable. The arillus surrounding the seeds is of a most brilliant blue colour, and yields an essential oil. The leaves are often used for thatching, &c.

TRAV'ERSES, in fortification, are usually masses of earth which are raised at intervals across the terreplein of a rampart or the covered-way of a fortress. On a rampart they serve to protect the guns and men against the effects of a ricocheting or enfilading fire, which might otherwise dismount the former, and compel the latter to abandon the parapet; and in the covered-way, besides serving for similar purposes, they constitute retrenchments behind which the defenders may keep up an annoying fire of musketry upon the enemy, should the latter attempt to force his way along the branches of that work. On this account they are provided with banquettes or steps, on which the defenders may stand to fire over them. Palisades are planted along the banquettes, in order to prevent the assailants from suddenly passing over the traverses; and at the passage between each traverse and the interior side of the glacis is a strong gate or barrier, which is closed in the event of the defenders being obliged to retire from one traverse to the next, or to abandon the covered-way entirely.

TRAV'ERTINE (Lat. *Lapis tiburtinus*), a famous building stone, deriving its name from the principal quarries at Tibur (the modern Tivoli) near Rome. Great beds of it exist along the Anio, &c. There is also a hill of a coarse variety of travertine, just outside the Porta del Popolo. It is a pure carbonate of lime, very hard, of a beautiful creamy colour, weathering into a delicious golden tint. It is a deposit from running water, and is highly stratified, with frequent cavities and fissures lined with crystalline carbonate of lime. Bits of stick and leaves are found frequently imbedded in it. It is an excellent building stone if laid in its natural bedding, but splits if set upright, because of its crystalline layers. The exterior of the Colosseum at Rome, the beautiful golden colour of which is known to all, is perhaps the most familiar example of travertine.

TREAD MILL, an instrument of prison discipline, invented by Sir William Cubitt, of Ipswich, which was formerly much used in the prisons of Great Britain, but which, owing to its excessive severity, and the impossibility of modifying it to the physical strength of individuals, has been to a great extent abandoned, and an appliance called the crank substituted. The tread mill consisted of a long cylinder, about 5 feet in diameter, whose circumference was planted with twenty-four equidistant steps. It revolved on its axis through the force supplied by the tread of prisoners, who were each shut up in a separate boarded compartment, and provided with a hand-rail to assist his movements. It revolved about twice in a minute, equivalent to a vertical ascent of 32 feet. The crank is a small wheel with flanges, like the paddle-wheel of a steam-vessel, which the prisoner, by turning an external handle, causes to turn round within a case filled, or partly filled, with gravel. A register outside the prisoner's cell records the number of revolutions made, and the task is rendered more or less arduous by the quantity of gravel in which the wheel revolves.

TREASON is derived from the French *trahison;* and in conformity with this derivation, the offences designated by it in English law always contained the notion of treachery, or a breach of that allegiance supposed to be due from an inferior to a superior. Thus petty treason was the murder of a husband by his wife, or a master by his servant, or a bishop by his subordinate in the church; and high treason consists in an attack upon the king as the political head of the state. The former of these two kinds of treason was abolished by 9 Geo. IV. c. 31, s. 2, which enacts that every offence which before that Act would have amounted to petty treason should be deemed to be murder only, and no greater offence. The term high treason is now seldom used, as most of the offences formerly known as high treason are now called treason felony. See the article HIGH TREASON.

TREASURE-TROVE, coin accidentally discovered (*troratus*). If coin, plate, or precious metals are found hidden in the earth or any private place, and the owner or person who deposited them is unknown, the property belongs to the king. But if the owner is known, or is ascertained after the treasure is found, the property belongs to him. By a constitution of Hadrian, the Roman emperor, if a man found treasure in his own ground it belonged to the finder, and also if he found it in a place which was *sacer* (sacred to the gods). If a man found treasure accidentally in another man's ground, the constitution gave half to the finder and half to the owner of the ground. If he found treasure in the ground of the emperor, the finder had half and the emperor half. To entitle the crown to the property, it must appear to have been hidden or deposited by some one who at the time had the intention of reclaiming it. Whenever, therefore, the intention to abandon appears from the circumstances—as, for instance, where the property has been found in the sea, or in a pond or river, or even openly placed upon the surface of the earth—it belongs to the finder. In England the concealment of treasure-trove from the king was apparently formerly a capital offence; at present it is a misdemeanour punishable by fine and imprisonment.

The same law prevails in Scotland, but by an order in exchequer, 20th January, 1859, an offer of reward is made, equal in amount to the intrinsic value of the articles, on the same being delivered up to sheriffs for behoof of the crown.

TREASURY, a department of the British government which controls the management, collection, and expenditure of the public revenue. The function of payment has, ever since the Restoration, been completely separated from the custody of the public revenue, the former only being vested in the treasury, while the latter belongs to the exchequer; and it is the business of this department to take care that no issues of public money are made by the treasury without their being in conformity with the authority specially enacted by Parliament. When money is to be paid on account of the public service, this is almost always done on the authority of a treasury warrant; and in other cases the countersign of the treasury is requisite. The Treasury Board consists of the first lord, the chancellor of the exchequer, and three junior lords, who usually have seats in Parliament, as have also the two political secretaries of the treasury. Previous to the reign of George I. the head of the treasury was called lord high treasurer, but since that time his office and functions have been executed by the lords commissioners. The first lord of the treasury has the power of controlling all the appointments made by the other members of the ministry; he appoints archbishops and bishops, and has the disposal of such crown livings as are not vested in the lord chancellor; and he is generally, but not necessarily, the prime

minister. The really effective head of the treasury is the chancellor of the exchequer, who also holds a distinct office as under-treasurer, and has a responsible control over the various branches of the service, and over all works involving unusual outlay in the naval, military, and civil departments, either at home or in the colonial possessions. He prepares every year an estimate of the national expenses, and proposes the ways and means by which they are to be met; and submits this statement, known as the budget, to the House of Commons. Occasionally the prime minister, when a member of the House of Commons, has held at the same time the office of chancellor of the exchequer. The really onerous duties of the board fall upon the secretaries, those performed by the junior lords being to a great extent formal.

All supplies for the various departments are issued under the authority of the treasury. The duties of the board comprise the examination of the expenses of legal establishments, sheriffs, county courts, and criminal prosecutions. The boards of customs and inland revenue, and the post office, are all subordinate to its authority, and the chiefs of these departments are to a great extent appointed by the lords of the treasury, who may be appealed to in all cases against decisions connected with the receipt of revenue. The offices of the treasury are in Whitehall.

TREASURY BILLS began to be drawn by permission of an Act of Parliament in 1877, previous to which time the treasury borrowed of the Bank of England sums required for a short time only. Treasury bills are always for three or six months, and never bear interest, for the purchaser buys them at a discount. They are thrown open to public tender, and frequently when interest is low as much as £99 16*s.* is bid for a three months' £100 bill, because of the absolute security of these instruments.

TREATY (from the French *traité*) means literally that which has been drawn up, or, in other words, arranged and agreed upon, by two or more parties, who are accordingly called the contracting parties.

Treaties relating particularly to individuals, such as the guaranteeing of the throne to a sovereign and his family, are known as personal treaties; while real treaties are those for national objects, independent of any change in the sovereignty, and these can only be made by sovereign powers, or by parties upon whom the sovereign power has conferred that right. In our constitution, for example, where the sovereign power consists of the king and the Parliament, the power of concluding treaties with foreign states generally belongs to the king, and is exercised by his ministers or those to whom he delegates the power. Should such ministers, however, conclude or advise treaties which shall be judged derogatory to the honour or disadvantageous to the welfare of the nation, they are liable to impeachment, a proceeding for which there are several precedents—chief among them being that of De la Pole, earl of Suffolk, 1451, for making a convention of peace without the consent of the Privy Council; of Wolsey, in 1529, by the House of Lords, for making treaties without the king's knowledge; and of the Earl of Oxford, by the Commons, in 1701, for advising treaties for dividing the dominions of Spain. In the United States of America the power is exercised by the president, with the advice and consent of the senate. No special form of words is necessary to insure the validity of a treaty, but it is usual to commit verbal agreements to writing as soon as possible. In warfare the power of limiting hostilities by truces, capitulations, or of making cartels for the exchange of prisoners, is recognized as incidental to the positions of generals, admirals, &c., these not requiring the ratification of the supreme authority, unless there be a reservation to that effect. Public ministers or other diplomatic agents are not entitled to conclude or sign treaties with foreign powers to which they are accredited, without a full authority besides the general letter of credence. Even in the case of a treaty concluded with full powers, it is often in important cases considered expedient to have a special ratification by the sovereigns or other proper authority of the contracting states.

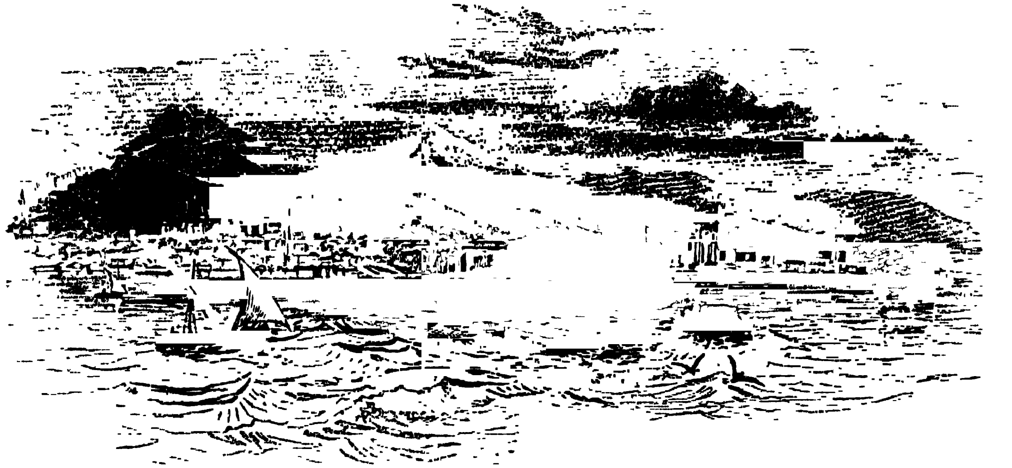
Treaties between nations for mutual commercial advantages have often been made, the best known of late years being that between England and France, in the negotiation of which Richard Cobden took a very prominent part, and which was productive of the greatest benefit to both countries. This treaty stipulated for the adoption on either side of a definite and detailed tariff of maximum duties. In the treaty as revised in 1872, France withdrew from this engagement; and after 1876 Britain was placed merely on the footing of what is called the most favoured nation—that is, British goods imported into France after the above date were not to be taxed more highly than the goods of the power which are least taxed. Commercial treaties, as a rule, are cumbrous expedients for effecting what may generally be done better by the nation which has most to give and is able to take most relaxing its own restrictive laws. These engagements, too, are for the most part only to be depended upon so long as they are for the advantage of the one party as well as of the other.

A *treaty of guaranty* is an engagement by which one state promises to aid another when it is disturbed, or threatened to be disturbed, in the peaceful enjoyment of its rights by a third power.

Treaties of offensive alliance engage the ally to cooperate in hostilities against a specified power or against any power with which the other may be at war; or if defensive, the engagements of the ally extend only to a war of aggression commenced against the other contracting power.

TREB'IZOND (ancient *Trapezous*), an ancient town, situated on the Black Sea, in the eastern corner of Asia Minor. It was a colony of Sinope, a town founded by the Milesians. Xenophon with his 10,000 Greeks came to it in his retreat ("Anabasis," iv. 8), and remained there thirty days. In the war with Mithradates the Romans took Trebizond, which henceforth belonged to their empire, and became a large and opulent city. Hadrian ordered the port to be secured by a mole. During the reign of Valerian (253–259) the town was taken and partly destroyed by Scythian barbarians, and fell into great decay till the reign of Justinian, who ordered the public buildings to be restored. It afterwards became the capital of a province which contained the ancient country of Pontos. In the middle ages the Genoese constructed a mole in the port of Trebizond, which is now almost entirely destroyed. At present the city, which is built on the slope of a hill declining to the sea, and backed by steep eminences rising behind, is the capital of the Turkish eyalet of Trebizond, the seat of the pasha of the province and of a Greek archbishop, and has a population of about 40,000, consisting of Mohammedans, Armenians, Greeks, and Christians. The Christians live chiefly in suburbs outside the town, where also the chief bazaars and khans have been established. Extensive gardens are contained within the walls, and outside are deep ravines filled also with gardens and crossed by long bridges. Among the public buildings the most remarkable are—the castle or citadel, partly of ancient and partly of modern construction, situated in the middle of the city on a steep rock, the summit of which is as flat as a table (Gr. *trapeza*, thence the name of the town); the bazaar; public bath-houses of marble; and the ruins of a temple of Apollo, part of which has been converted into a Greek chapel. There are numerous mosques and Greek churches; manufactures of linen and cotton stuffs, and articles in copper, which is brought here in a rough state from the mines in the interior. A mine of argentiferous lead at

Guercli, 20 miles W. of Trebizond is, however, the only one now worked in its neighbourhood. Its geographical situation renders it admirably adapted for commerce, and its trade much increased after the establishment of lines of steamers, by which it has direct and regular communication with Constantinople, Odessa, and the Danube, and is thus made the great entrepôt of the commerce between Eastern Europe and Central Asia. Since the transfer of Batoum to Russia, however, under the treaty of Berlin, Trebizond has suffered by much of this trade being diverted to Russian hands. The chief imports are cotton manufactures, hardware and fire-arms, cutlery, tin, grain, and



Trebizond.

colonial goods; the exports, which are mostly brought in caravans from Erzeroum, Tabriz, and Syria, consist of copper, carpets, and shawls, silk, gall-nuts, camel skins, wool, tobacco, wax, oil, opium, and drugs. The harbour, which is considerably to the east of the old town, is protected by a mass of high rocks, running out N.N.W.

TREBLE, in music, the highest part in a concerted piece. In vocal music it is sung by boys or high-voiced women. The term arises from the fact that the part was the third part above the tenor or cantus, originally the principal voice, in mediæval times. To this was added a *discant*, or second song, and above that a *triplum*, a *quadruplum*, and so on. Beneath all was the bass.

TRED'EGAR, a town of England, in the county of Monmouth, situated on the N.W. border of the county, 179 miles from London by the Great Western Railway, is the capital of a populous district, intersected by numerous lines of railway, and famous for coal mines and iron works. The population of the town in 1881 was 18,771. A few years ago it was an insignificant village.

TREE-CRAB or **ROBBER-CRAB** (*Birgus latro*), is a species of HERMIT CRAB (Paguridæ), a native of the Moluccas, Keeling Islands, and other islands in the South Pacific Ocean. The tree-crabs live on the land in deep burrows, which they excavate beneath the roots of the cocoa-nut trees, which they are said to climb for the purpose of obtaining the fruit. Its chief, if not sole, food consists of cocoa-nuts, the edible portion of which it extracts in a very remarkable way. According to Darwin ("Voyage in the Beagle"), it "begins by tearing the husk, fibre by fibre, and always from that end under which the three eye-holes are situated. When this is completed, the crab commences hammering with its heavy claws on one of these eye-holes till an opening is made; then, turning round its body, by the aid of its posterior pair of narrow pincers it extracts the white albuminous substance." This crab grows to a large size. The first pair of legs are furnished with very strong and heavy pincers, and the last pair are very small and slender, furnished with small, weak pincers; the second and third pairs are not chelate. These crabs are a favourite food with the natives, and the tails of the larger specimens yield a large quantity of oil.

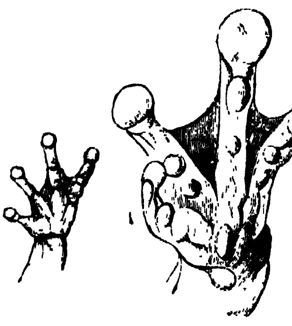
TREE-CREEPER. See CREEPERS.

TREE-FERN is the name given to those species of FERNS which assume an arborescent form, owing to the development of a woody erect stem. They are found only in tropical and subtropical countries. The stem is generally slender, from 20 to 50 feet or more in height, bearing a head of fronds; it is usually marked with scars, which mark the position of the fronds which have fallen off. The tree ferns belong to the tribes Cyatheæ and Polypodieæ. See CYATHEA.

TREE-FROG (Hylidæ) is a family of BATRACHIA, distinguished by having the toes dilated at the extremities into discs, which are covered with a viscid secretion and adapt the animals for clinging to the leaves and stems of trees. The tree-frogs are generally smaller and more graceful in form than the true frogs (Ranidæ), and most of them are adorned with brilliant colours. They live on trees, pursuing among the foliage and branches with great agility their prey, which consists of insects, worms, &c. Some species leave the trees and retire to ponds to spawn, while others lay their eggs in the water collected in the hollows of trees. Most of them hibernate in the mud. The males are provided with large vocal sacs, and their croaking is louder than that of the true frogs.

Only one species of tree-frog is found in Europe. They are most abundant in the warmer parts of the world, especially in tropical America. The Common Tree-frog (*Hyla arborea*) is widely distributed on the continent of

Europe, but is not found in Britain; it is also found in North Africa, and ranges in Asia as far as China. It has a short, thick head, large projecting eyes, a thick, round tongue, a short body of a somewhat triangular figure, and a smooth skin, except under the throat, chest, and belly. The hinder limbs are of considerable length, and the toes are partially webbed. The general colour on the upper parts of the body is a fine, delicate green, except on the toes, which present a slight rosy hue, whilst the under surface is white. A yellow stripe bordered with pale violet stretches along the sides of the head and body, and down the hind legs to the feet, while a similar stripe branches off and extends down the arms to the fore feet. After the breeding season, however. the animal becomes of a reddish-brown, which soon changes to gray, mottled with spots of



Fore-feet of Tree-frogs.

a reddish hue. The colour next assumed is one passing into blue, and in spring this changes again to its proper livery, green. The males are always larger than the females, and possess large vocal sacs under the throat. These when swollen up resemble a protuberance as large as the whole head, which at such times appears like a large globular bladder. The tree-frog is generally found in moist woods and in hedges near water. It feeds chiefly on insects, in pursuit of which it displays wonderful alertness and agility, making leaps of several feet. The Common Tree-frog of North America (*Hyla versicolor*), found in the Northern United States, is more toad-like in form. The ground colour varies from pale ash to dark brown, and is blotched with brown, green, white, and yellow. The Golden Tree-frog (*Hyla aurea*) is common all over Australia, where the natives often use it for food. Another North American tree-frog is *Acris gryllus*, a small species, inhabiting the southern states of the Union. It is often called the Savanna cricket, from the chirping noise which it makes.

TREES. See ARBORICULTURE, FORESTS, and TIMBER.

TRE'FOIL, in architecture, an ornament of three cusps in a circle, like three-leaved clover—from the Latin *trifolium* (*tres*, three, and *folium*, a leaf).

TREMAD'OC SLATES, in geology, a series of dark earthy shales and slaty beds, so called from their typical development in the neighbourhood of Tremadoc, in Carnarvonshire. They rest conformably upon the Lingula Flags and beneath the Arenig Beds, and are variously classed as upper CAMBRIAN or lower SILURIAN. Fossils are numerous in many localities, and the formation is of special interest to palæontologists, on account of the occurrence of GRAPTOLITES and CEPHALOPODA, which have not hitherto been discovered in any earlier deposits.

TREMAN'DREÆ is a small order of dicotyledonous plants, belonging to the group POLYPETALÆ, cohort Polygalinæ. [See BOTANY.] It consists of slender shrubs very much resembling heaths, all natives of Australia, and of no known use. They have small entire leaves, and red, blue, or white regular flowers. The sepals are four or five, and valvate; the petals four or five, and spreading; the stamens are eight or ten, free, hypogynous, with the anthers opening by terminal pores; and the ovary is free, usually two-celled, with from one to three pendulous ovules in each cell.

TREMAT'ODA is an order of parasitic worms, belonging to the class PLATYELMINTHA. The Trematoda or flukes are external or internal parasites. They are unisegmental worms with a flat, broad, leaf-shaped body; rarely they are cylindrical in form. On the ventral surface are one, two, or more suckers. The mouth is suctorial, and there is no anus; the greater portion of the alimentary canal is frequently aborted in the internally parasitic forms. There is no vascular system, and the nervous system is simple. There are a pair of excretory organs (nephridia), which in some are enormously branched. The male and female organs are united in the same individual, and open by a single pore on the ventral surface. The development is often very complex.

This order is divided into two suborders, Digenea and Monogenea. The Digenea present the phenomenon of alternation of generations, passing the first stage of their existence generally in invertebrate, and the last or sexual in vertebrate animals. In the common LIVER FLUKE (*Fasciola hepatica*), which causes the rot in sheep, the eggs are hatched as ciliated embryos, which make their way into the body of a small snail, *Limnæus truncatulus*. In this situation the embryo grows and changes its shape and produces asexually a number of organisms called Rediæ; the latter in their turn produce asexually other organisms called Cercariæ, which either escape or are swallowed together with the snail by the sheep, when they get into the liver and become transformed into the adult sexual fluke. This species is found not only in the sheep, but in other herbivorous mammals, and occasionally in man. *Bilharzia hæmotabia*, found in the bloodvessels of man, is a common parasite in Egypt, and is also found in South Africa and the Mauritius. It is not hermaphrodite, the female being small and lodged in an abdominal groove of the male, which is cylindrical and about half an inch in length. The Monogenea develop direct from the egg. Many of them are external parasites, being found on the gills and skin of fishes, on molluscs, crustaceans, &c. They have frequently many suckers, some of which often have hooks. *Diplozoon paradoxum* is a remarkable form found on the gills of the fresh-water bream. Two animals, each of which is hermaphrodite, join together by their suckers and fuse, a solid band of tissue being formed between them.

TREM'OLITE is a variety of HORNBLENDE, mainly a double silicate of lime and magnesia, and occurs chiefly in talcose and magnesian rocks. It is white or of a grayish tinge, and sometimes nearly transparent; and is so named from its abundance in the vicinity of Tremola, in Switzerland.

TREM'OLO, in music, a direction for one of the graces of melodious expression, consisting in the tremulous reiteration of a single note, or in a general shake of the whole chord. The latter is also called *Tremolando*. The tremolo stop on the organ and harmonium is effective if not abused. It acts by supplying an intermittent stream of air to the pipes or reeds. It is also called *Tremblant* and *Tremulant*.

TREM'ULANT. See TREMOLO.

TRENCH (Fr. *tranchée*), in military works, is an excavation in the ground, from 12 to 18 feet wide and 3 feet deep, and generally of considerable length, the earth being thrown upon one side in order to form a sort of parapet by which the soldiers in the trench may be covered from view or protected from the fire of the enemy.

TRENCH, RICHARD CHENEVIX, D.D., Archbishop of Dublin, was born 1807, and received his later education at Trinity College, Cambridge. He published

in 1835 a volume of pleasing verse, the "Story of Justin Martyr, and other Poems," followed in 1838 by "Sabbatim, Honor Neale," &c.; by "Genoveva" (1842); and in the same year by the interesting "Poems from Eastern Sources." In 1845 Mr. Trench was appointed rector of Itchinstoke, Hampshire. Besides the Hulsean lectures for 1845–46, he published many sermons and minor works. Prominent among the latter are his instructive little volumes—"The Study of Words" (1851), and "English Past and Present" (1855), which have gone through many editions. He was one of the editors of the "Speaker's Commentary," and was always engaged in important religious literary work. In 1856 he succeeded Dr. Buckland as Dean of Westminster; and in 1863 was appointed Archbishop of Dublin in room of Dr. Whately. He resigned this office in 1884, but devoted much attention to the reorganization of the Irish Church after its disestablishment, a measure he throughout strenuously opposed. He died in London, 28th March, 1886.

TRENCK, FRIEDRICH VON DER, BARON, author of the celebrated "Memoirs," was descended from one of the noblest families in Prussia, and was born at Königsberg in 1726. In 1742, when only sixteen years of age, he obtained admission as a cadet into the famous body-guards of Frederick the Great. His excellent abilities and extensive acquirements attracted the attention of the king, who in the course of a few weeks gave him a cornet's commission, along with a splendid equipment for the service. The young baron distinguished himself in a campaign against Austria by his signal bravery, and had every prospect of winning his way to the highest honours, when his imprudence ruined all hope of advancement. He contracted an attachment to the king's sister, and having further displeased the king by accepting presents from Austrian officers, he was suddenly arrested in 1745, and sent as a prisoner to the citadel of Glatz. After several unsuccessful attempts he at length effected his escape in a most extraordinary manner, and after suffering terrible hardships, succeeded in reaching Vienna in April, 1747, and entered the service of Austria. In 1754, on the death of his mother, he proceeded to Dantzic to settle some family matters, and there, by a flagrant violation of international law as well as justice, was seized by a body of Prussian troops and conveyed to the strong fortress of Magdeburg. He was there treated with great barbarity. His repeated and all but successful efforts to escape increased the severity of his confinement. In 1755, by the direct orders of Frederick himself, the unhappy youth was transferred to a horrible dungeon, handcuffed, loaded with enormous fetters, an iron collar fastened round his neck, and his feet chained to a bar which allowed him to move only 2 or 3 feet; yet by an almost superhuman exercise of strength, skill, and industry, he on three several occasions all but regained his freedom. At length, after the conclusion of the war between Austria and Prussia in 1763, he was set at liberty, having undergone an imprisonment of eleven years. He took up his residence in Aix-la-Chapelle, where he married the daughter of a burgomaster and carried on business as a wine merchant. He then spent six years on his estates in Hungary, engaged in agricultural pursuits. He published, in 1787, his memoirs of his own life, which produced an extraordinary sensation, and were translated into almost all European languages. In 1791 Trenck visited France, having eagerly adopted the revolutionary doctrines prevalent in that country, but he was denounced as a spy, thrown into prison, and ultimately guillotined, 25th July, 1794.

TRENT or **TRIENT,** a town of Austria, in Tyrol, situated on the Adige, 46 miles from Verona, in a beautiful and fertile valley surrounded by high mountains. The houses are very high, with flat roofs, the streets tolerably wide and well paved, with broad flat pavements for pedestrians. Altogether the town is thoroughly Italian in appearance, and with its embattled walls and numerous spires and towers it looks very imposing when seen from a distance. It is traversed by canals. It contains a fine square, the Piazza Grande, in the centre of which is a handsome fountain of red marble. Of the churches the most remarkable is the cathedral, a large edifice in the old Greek style, entirely of marble, which was begun in the tenth and finished in the sixteenth century. The church of Santa Maria Maggiore, built entirely of red marble, is memorable as having been the place in which the Council of Trent held its sittings from 1545 to 1562. The church of the Jesuits is richly ornamented with foreign marble. Among the other buildings are two episcopal palaces, fine court-house, capacious theatre, a number of elegant private palaces, convents, ecclesiastical seminary, gymnasium, school of design, foundling hospital, ordinary hospital, and several other charities. Near the town is the Palace Buonconsiglio, a fine specimen of the feudal architecture of North Italy, but now used as a barrack. Trent is the residence of a bishop; it has 18,000 inhabitants, whose occupations are the silk manufacture and the cultivation of the vine. There are in the city extensive sugar refineries, a large imperial tobacco manufactory, and many distilleries of brandy and spirits of wine. The town is also the seat of a very extensive transit trade between Italy and Germany, and in the vicinity are marble quarries.

TRENT, a river of England, the third in respect of size, rises at a height of about 500 feet above the sea, in the upland moors of West Staffordshire, near the Mole Cop, and flows first south-east through the county till, reaching the south part of Derbyshire, it gradually bends round the subsiding ranges of the Pennine chain, and flows north-east and north through the counties of Nottingham and Lincoln, and joins the estuary of the Ouse to form the Humber. To Burton-on-Trent, 60 miles from its source, the fall is 376 feet, thence to its mouth the current is very gentle. Barges ascend as high as Burton, and vessels of 200 tons to Gainsborough, at the head of the tide-water. Its total length is 167 miles, and the area of its basin is 3972 square miles.

TRENT, COUNCIL OF, one of the most important councils of the Roman Catholic Church, first sat on 13th December, 1545, and continued (with interruptions) under Popes Paul III., Julius III., and Pius IV., to 4th December, 1563, when its last sitting (the twenty fifth) took place. The objects of the council were to effect a reformation of the church, to define more explicitly the impugned doctrines of the church, and, if possible, to induce the Protestants to return to the old faith. The council decreed, with anathemas, the canon of scripture (including the Apocrypha), and the church its sole interpreter; the traditions to be equal with scripture; the seven sacraments [see SACRAMENT], transubstantiation, purgatory, indulgences, celibacy of the clergy, auricular confession, &c.

TREN'TON, a town of the United States, the capital of Mercer County, New Jersey, situated 56 miles south-west of New York, at the head of the navigation of the Delaware River, here crossed by two bridges. It is a well-built town, with important manufactures, especially of iron goods and crockery. Its chief buildings are the state house, an old edifice, post-office, arsenal, penitentiary, asylum, and several churches. The population in 1880 was 34,386. It is famous in the history of the American Revolution for the victory gained over the British and Hessians on 26th December, 1776, by the troops under Washington.

TREPANG. See BÊCHE-DE-MER and SEA CUCUMBER.

TREPAN'NING, the operation of cutting out a piece of bone, especially a piece of skull, to relieve pressure on the brain, often produced by a bad fracture, &c.

—a small plate of silver being then fitted over the orifice. The instrument used is called a trephine. The operation is extremely dangerous and not resorted to except under absolute necessity.

TREPH'INE. See TREPANNING.

TRES'PASS is a wrong directly done to the person, to the goods and chattels, or to the lands and tenements of any man.

To the person it may be by menace, assault, battery, or maiming [see ASSAULT]; to either dead or live chattels, by taking them away or by injuring them; to lands and tenements, by entering upon them and injuring them. Trespass is the action by which a person in the actual and exclusive possession of property is protected against the forcible interference with it by those who are not entitled to it. By this action also he may recover damages for the injury done to his possession.

The possession which is sufficient to entitle a man to bring this action against a stranger is a bare possession without any proof of further title to the property; but the possession must be actual: an heir who is entitled to lands, but has never entered upon them, has no claim to this means of redress. The possession also must be exclusive: one who has only a right of common cannot bring an action for trespass for an injury done to the common, since others have rights co-existent with his own. A tenant during the existence of his demise may maintain it against the landlord himself if he enters upon the premises except for a lawful cause, as to distrain. The mere possessor of goods or cattle may maintain trespass against a stranger. With respect to goods, possession may be said to be of two kinds, possession in fact and possession in law, sometimes distinguished by the terms actual and constructive possession. Either kind is sufficient to enable the possessor to maintain trespass. It is constructive if the property of goods has vested in a party, the mere property in such case being construed to draw after it and invest the owner with possession also.

To constitute trespass, the act done must be wilful, not the result of negligence, and have something of force in it, and the injury must be the immediate not the consequential result of the act. But it is not necessary that it should be done with the design to cause the injury complained of; it may be caused by mistake or ignorance. If one shooting at a mark hits a bystander, he is guilty of trespass. A sheriff commits an act of trespass if he takes the goods or arrests the person of B, mistaking him for A. In trespass, all persons who assist in the act done, or cause it to be done, or, if it is for their use, assent to it afterwards, are considered as principals, although not actually present at the doing of the act. If an act is done by a servant wilfully, and in the discharge of his business as servant, the master is liable. But if it is not in discharge of his master's business, the latter will not be liable.

Under the 24 & 25 Vict. c. 97, jurisdiction of trespass is in many cases given to magistrates to inflict punishment, and to award compensation to the parties injured.

In Scotland trespass at common law is prevented by *Interdict*, similar to the English *Injunction*. There are special Acts to prevent trespass for game and salmon, and trespass on lands or other premises by vagrants, tinkers, &c., is punished under 28 & 29 Vict. c. 56, by fine or imprisonment.

TRÈVES. See TRIER.

TREVI'SO or **TREVIGI**, a city of North Italy, on the Sile, in the government, and 6 miles north of Venice, on the railway from thence to Trieste. The surrounding country is level and fertile, producing wine, silk, &c. The city has spacious streets and large squares, and a very pleasing appearance. The principal buildings are the cathedral, a fine but unfinished structure of the Lombards; the Church of San Nicolo, a large Gothic edifice; the court-house and prison, town-house, register-office, hospital, library of 30,000 volumes, a *monte-di-pieta*, two theatres (both handsome buildings), and the civil hospital. The manufactures consist chiefly of silk and cotton goods and cutlery; the trade is in corn, cattle, and fruit, and there is an important annual fair which lasts fifteen days. Treviso is the see of a bishop, the seat of provincial and city courts and offices; and possesses a botanic garden, agricultural society, diocesan seminary, and athenæum of science and literature. It was formerly the seat of the celebrated university afterwards transferred to Padua. The population of the town in 1882 was 31,219. It is a place of great antiquity, and is supposed to have been a municipal free town under the Romans. On the decline of the empire it was taken possession of by the Huns, then by the Ostrogoths, and by the Lombards, who made it the capital of their two margraviates, under the name of Marca Trevigniana. During the feuds between the Guelphs and Ghibellines it formed part of the Lombardic league, and became independent. In 1344 it voluntarily placed itself under the government of Venice, whose fortunes it has since followed. Totila, king of the Goths, and Pope Benedict XI. were born in Treviso. Under the French it was the capital of the department of Tagliamento. Napoleon conferred the title of Duke of Treviso on Marshal Mortier.

TRI'AD, in music, a chord made of a bass note, its Third and its Fifth, and called major or minor according to the quality of its Third. The Seventh of the scale bears a triad with an imperfect Fifth, and is hence called the imperfect triad. The Third of the minor scale bears a triad with an augmented Fifth, and is hence called the augmented triad. The Second of the minor scale bears an imperfect triad.

TRI'ADS, the poetical chronicles of the Welsh bards, in which all the facts recorded are thrown into the form of triplets. They are not of greater antiquity than the reign of Edward I.

TRIAL, the means adopted for the purpose of ascertaining facts in issue in common law proceedings, whether civil or criminal. Formerly the equity courts had the power, where they thought convenient, in the case of disputed facts, to direct an issue to be tried at common law: under the Judicature Act all divisions of the high court of justice may try cases with a jury. The kinds of trial are properly only two: (1) that where the court itself decides upon the evidence without the intervention of a jury; (2) that where the jury decides.

A peer of Great Britain indicted capitally is entitled to be tried by the peers of Parliament assembled in the court of the Lord High Steward of Great Britain, who is a peer nominated to that office by the crown for the occasion. The proceedings of the trial are carried on in the same way as on a trial by jury, and judgment is pronounced according to the opinion of the majority, which must consist of at least twelve. Cases of impeachment by the Commons are also tried by the Lords.

A Trial at Bar resembles the ordinary cases of trials by jury, except that instead of its being presided over by a single judge, all the judges of the court are in attendance. It is granted on application to the court, but only in cases of great difficulty and importance. The last occasion was in the case of the Tichborne claimant, in 1873-74. In informations exhibited by the attorney-general he is entitled to a trial at bar.

New Trial. After a trial has been already had, it is competent to the court in which the action is brought to grant a new trial, on an application made and grounds shown for supposing that justice has not been done between the parties, and that the case is of sufficient importance to warrant such a further expense. These grounds are various, such as a misdirection by the judge, a verdict against evidence, excessive damages, misconduct of the jury, &c.

In Scotland jury trial in civil cases is confined to the Court of Session, but the trial may take place at the circuit court of the district to which the subject matter of the action belongs. Trial at bar before the full bench or more than one judge is unknown. In civil cases the number of the jury is twelve. Unanimity is not essential. After having been three hours in deliberation, the verdict of a majority may be taken. A lord ordinary may take trials and give a special verdict without a jury, and by consent of parties a lesser number of jurors may be taken in civil cases. In sheriff courts trial by jury in civil cases is unknown, except under some special statutes; but a case above £40 may be removed to the Court of Session for trial by jury. In criminal cases trial by jury is competent both in the Court of Session and sheriff courts, but the jury consists of fifteen and the verdict may be by a majority.

TRIAL BY BATTLE. Trial by battle was unknown to the Greeks and Romans, but it was a natural growth of the mingled superstition and ferocity that characterized the centuries of war, confusion, and change which followed the fall of the Roman Empire and preceded the establishment of the kingdoms of modern Europe. It first arose in Germany, and the Germans introduced it into France. It was allowed both in civil and criminal affairs, was regulated by law, reduced to a system, and attended by many curious ceremonies, which were strictly observed and rigidly enforced, and which will be found minutely described in the "Style" of Dubreuil. Gondebaud, king of the Burgundians, was the first who legalized it, in the year 501, by a formal law called Loi Gombette, which runs in the following terms:—"We have observed with pain that the obstinacy of pleaders and a censurable love of gain have corrupted the administration of justice among our subjects to such an extent that, very frequently, they do not hesitate to swear as to things of which they are ignorant, or to perjure themselves with regard to the facts which they know. Anxious to put an end to such criminal practices, we ordain, by the present law, that whenever a cause shall arise among our subjects, and the defender or accused shall have offered to deny on oath that he owes what is demanded of him, or that he has done that of which he is accused, the difference shall terminate in manner following:—We will that the judges refuse not the combat, if the party to whom the oath would have been offered refuses it and declares, confident in the truth of his cause, that his adversary may be convicted by force of arms." It thus appears that the prevalence of perjury, as well as the superstitious idea that God would interfere to protect the innocent and punish the guilty, had a good deal to do with the institution of the judicial combat or trial by battle. Three hundred years afterwards the capitularies of Charlemagne admit and regulate it; but in a capitulary of 805 an attempt is made to stop the effusion of blood by ordering the royal officers to exert every effort to appease private quarrels, and in the event of their failing to do so, they are required to bring the parties before the emperor, in order that he may try to reconcile them. Two canons of the Council of Valencia, held in 855, also show the beginning of a reaction against this absurd and bloody practice; but it was too strongly established to be easily overthrown, and too much in accordance with the faith and the manners of the age; and up to the reign of Charles IX. of France—or the latter end of the sixteenth century—we find ordinances authorizing and regulating it in all sorts of affairs. It was definitely abolished by an ordinance of that monarch in 1566. To such an extent was the practice carried in France in the twelfth century, that Louis VII. was obliged to promulgate a law forbidding resort to it for a less sum than £2 15*s.* of our money. So that for that sum, and anything above it, a pugnacious litigant might peril his own life and compel his opponent to risk his also. The trial by battle was never so common or so popular in England as it was in France. It was, however, allowed in doubtful cases, and especially where a crime not capable of notorious proof was charged. The gentleman fought on foot or on horseback, with all his weapons of attack and defence; the plebeian on foot, with a club and target. Women and ecclesiastics, who could not combat in person, were allowed to fight by a champion. If the combat related to a civil matter the vanquished party lost his claims and paid a fine; if he fought by proxy, his champion was liable to have his hand struck off. In criminal cases the appellant suffered, in the event of a defeat, the same punishment which the law awarded to the offence of which he accused his adversary. We still possess in the modern duel a relic of the trial by battle—the former being based upon a false sentiment of honour, as the latter was founded upon a false belief in the interference of God. The duel is now happily almost extinct; but in former days, and especially in France, it shed rivers of blood. Seconds as well as principals fought, and for the most trifling causes—often merely to decide who was the bravest and the better swordsman. Nay, sometimes a challenge was thrown into the air; and the fool who threw it, and he who happened to pick it up, fought it out with their rapiers. Henri IV. complained that he lost more gentlemen in duels than in his wars; and it has been estimated that during his reign no fewer than 8000 persons fell victims to this cruel and senseless practice.

TRI'ANGLE (Lat. *tres*, three, and *angulus*, a corner), the simplest of geometrical figures, is a figure having three angles, and consequently three sides. This consequence is usually made the definition; and the same thing occurs in Euclid, whose word is *trigonon* in the "Elements," though it is *tripleuron* in the definitions prefixed.

A triangle may be drawn upon any surface, and have any sort of lines for its sides; but it is not usual to consider any except plane triangles drawn on a plane with right-lined sides, and spherical triangles drawn on a sphere with arcs of great circles for the sides.

The two most important properties of the triangle are, that the sum of its angles is always two right angles, and that the area is half that of a rectangle of the same base and altitude. Both of these propositions admit of such practical verification as would make them perfectly intelligible to those who do not understand geometry. Take the greatest angle, B A C (fig. 1), of a triangle cut out in

Fig. 1.

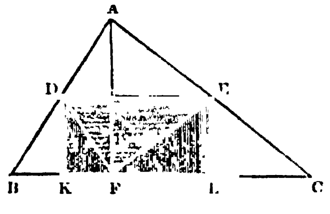


Fig. 2.

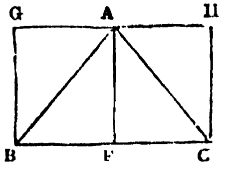
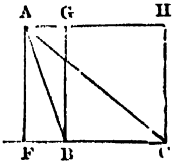


Fig. 3.



paper, and fold the paper so that A may rest on B C at F, the part A D E folding over D F E. Then it will be found that by further folding, E C L can be brought over E F L, and B D K over F D K, so that the three angles of the triangle, K F D, D F E, and E F L, are so placed that the first side of the first and the last side of the last, K F and F L, are in the same straight line, and the three make up the two right angles

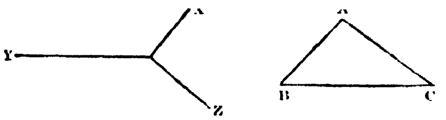
K F A, A F L. Again the triangle B A C is either the sum (fig. 2), or difference (fig. 3) of the two right-angled triangles F A C, F A B, which are the halves of the rectangles F A H C, F A G B, the sum or difference of which is the rectangle B G H C; whence the triangle is the half of the rectangle B G H C.

The three lines which bisect the angles of a triangle meet in one point, which is the centre of the inscribed circle; and the three perpendiculars which bisect the three sides also meet in one point, which is the centre of the circumscribed circle. Moreover the three lines drawn from the vertices bisecting the sides meet in one point, which is the centre of gravity of the triangle. The three perpendiculars drawn from the vertices to the sides also meet in one point.

The number of isolated theorems which might be given on this subject is very large, but there is little, unconnected with the trigonometrical formulas, which is of use in application. The chief varieties of triangles are the equilateral, isosceles, right-angled, acute-angled, obtuse-angled, and scalene.

TRI'ANGLE, a simple musical instrument made by a bar of steel bent into a triangular form, the third angle being not quite completed. It hangs suspended from one hand, and is struck with a small steel bar by the other. Occasionally used in orchestral compositions, it produces a very characteristic effect.

TRI'ANGLE OF FORCE. If three forces acting on a point be in equilibrium, then they will be represented by a triangle whose sides equal the forces in magnitude and direction.



Thus the figures X, Y, Z, are represented by the sides A B, B C, C A of the triangle A B C, the sides being all read in the same direction. Hence if we represent the direction and magnitude of two forces by lines, we can find the magnitude and direction of the third by joining the extremities of these lines.

TRIAN'GULA and **TRIAN'GULUM AUSTRA'LE.** The first (the Triangles) is a northern constellation, surrounded by Perseus, Andromeda, Aries, and Musca. There is also the Little Triangle, added by Hevelius. The second, or Southern Triangle, is a constellation of Bayer, lying between Ara, Centaurus, and the South Pole. See Plates CONSTELLATION.

TRIAS'SIC SYSTEM, in geology, the series of rocks forming the upper division of the NEW RED SANDSTONE of the earlier geologists. The formation rests unconformably upon the Permian strata beneath, and passes gradually, through the intervention of the RHÆTIC BEDS, into the Jurassic system above. It is the series in which fossils characteristic of the Mesozoic age of the earth's history first appear in Europe and America, and is thus a formation of considerable interest. In European areas the rocks are, for the most part, red and mottled sandstones and indurated clays (marls), though, on the Continent, a thick shelly limestone is also met with in the middle portion of the group. In Germany, the latter deposit is especially well-developed, and the system receives its name from its threefold division in that country; in England, however, the limestone is entirely absent, or possibly only represented by a thin conglomerate in the neighbourhood of Bristol.

The Bunter beds, so-called from the German, in allusion to their mottled or variegated colouration, attain a maximum thickness in England of 1500 feet, and are occasionally worked for building stone and for the manufacture of foundry moulds. Owing to their porous character, and the presence of much oxide of iron, fossils are extremely rare, and none but plant-remains and footprints appear to have been hitherto detected in this country. Silicified trunks of trees have been met with in the neighbourhood of Coventry, Warwickshire, and numerous hand shaped footprints (Cheirotherium), with ripple marks and rain pittings, are discovered in the quarries of Storeton Hill, near Birkenhead, Cheshire. The footprints indicate an animal with very small fore-limbs, occasionally walking erect like the kangaroo, and almost certainly belonging to the amphibian order of LABYRINTHODONTA.

The following table, compiled by Dr. David Page, will indicate the character of the divisions in Europe:—

	Germany.	England.
1. UPPER TRIAS or KEUPER,	Saliferous and gypseous shales, with beds of variegated sandstones and carbonaceous laminated clays.	Saliferous and gypseous marls, with gray and whitish sandstones.
2. MIDDLE TRIAS or MUSCHELKALK, . .	Compact grayish limestone, with beds of dolomite gypsum and rock salt.	Wanting
. LOWER TRIAS or BUNTER,	Various coloured sandstones, dolomites, and red clays; occasional pisolites.	Reddish sandstones, and quartzose conglomerates.

The "dolomitic conglomerate" of the neighbourhood of Bristol rests immediately beneath the upper Trias, and is of great interest on account of its yielding remains of old DINOSAURIA, Palæosaurus and Thecodontosaurus. It is but a thin stratum, and consists of fragments of older rocks cemented by red and yellow dolomite.

The Muschelkalk (Ger., "shell-limestone") is a truly marine deposit, and contains numerous fossils. The most interesting of these is a primitive type of AMMONITE, named Ceratites, in which the foldings of the sutures are not so complex as in the genera of later date. The encrinite, *Encrinus liliiformis*, is also a common and characteristic fossil, and there are several bivalved Mollusca. Marine reptiles, such as Placodus and Nothosaurus, likewise occur, and are evidently forerunners of the Plesiosaurs, so typical of the Jurassic period.

The Keuper beds, so called from the copper-bearing nature of certain layers, form the most important division of the Triassic system, from an economic point of view. In Cheshire they are believed to attain a total thickness of about 3000 feet, and comprise the beds of rock-salt so largely worked in that county. Copper, cobalt, nickel, and other metals were also obtained, until quite recently, from the soft sandstones of Alderley Edge, in Cheshire; and there are numerous quarries in the more indurated Keuper sandstones, wherever accessible, these furnishing a most valuable building material. The lowest layers are known as the *waterstones*, from the copious supply of water they yield when "tapped." As in the case of the Bunter beds, the Keuper sediments afford evidence of having been deposited in an inland sea highly charged with mineral matter, and thus yield scarcely any fossils. A small bivalved crustacean, *Estheria minuta*, occurs in certain layers, and fishes are represented by the ganoids, Semionotus and Dipteronotus, and by the shark, Hybodus. A recent discovery of fish-remains in the Warwickshire Trias was reported to the Geological Society of London in June, 1887. Bones and teeth of Labyrinthodonts are also occa-

sionally met with, and the well-known teeth of Labyrinthodon (Mastodonsaurus), described by Owen, were obtained from these beds. Among these reptiles there are the remains of a lizard-like animal, Hyperodapedon, most nearly allied to the living Tuatera lizard of New Zealand; and the Keuper sandstones of Elgin and Lossiemouth, in the Scotch Highlands, have also yielded a primitive crocodile, Stagonolepis. (See papers by Professor Huxley in *Quarterly Journal, Geological Society*, London, 1875 and 1887.) Another crocodile, Belodon (Phytosaurus), is met with in the corresponding strata on the Continent, near Stuttgart, and is associated with several reptiles of a primitive type.

Triassic strata have also been recognized in India, South Africa, North and South America, and Australia, and in all have been discovered vertebrate fossils not unlike those of Europe. Hyperodapedon and Belodon occur in India, and the latter in North America. Numerous tridactyl footprints are found in the Trias of the Connecticut Valley, U.S.A., and were evidently made by Dinosaurian reptiles. From South Africa, the curious Dicynodon and its allies have been described by Sir Richard Owen, and the same distinguished anatomist has also made known a mammalian skull (*Tritylodon longævus*) from that country. Other mammalian genera, Dromatherium and Microconodon, occur in the Trias of North Carolina, and these constitute the earliest evidence of the highest class of the Vertebrata hitherto discovered.

TRIBES (Lat. *tribus*, probably akin to the numeral *tres*, and the Æolic Greek *trippos* or *trittos*, a third-part), a subdivision of the Roman people, which appears to have existed from a remote antiquity. According to Dionysius, Romulus originated this classification, dividing his subjects into three tribes, and each tribe into thirty curiæ. These three are stated by Livy to have been the Ramnes, Tities, and Luceres. Servius Tullius swept away his predecessor's disposition, and re-arranged the people into twenty-six tribes, according to one authority, or thirty-one, according to another. Niebuhr suggests that ten of these were lost by the cession of the lands on the Etruscan bank of the river to Lars Porsena, as Livy records only twenty-one tribes in existence soon after the great battle of the Lake Regillus, which number remained without alteration for at least a century. The whole question, however, is involved in an atmosphere of obscurity which the keenest speculation cannot satisfactorily penetrate.

Long before the foundation of Rome other nations had been divided into tribes, the number varying from three, as among some of the Greek peoples, to twelve, as among the Hebrews. Slaves were not counted as tribesmen. This division, like that of the Celtic clans, was based essentially on a religious foundation, each tribe having its common sacrifices and festivals. At Athens there were always four tribes, and though their designation varied at different times they always had a common character. Thus we find them called Dias, Athenais, Poseidônias, and Hêphaistias, after Zeus, Athena, Poseidôn, and Hêphaistos, the four chief Attic deities; and later on Geleontes, Hoplêtes, Argadeis, and Aigikoreis, after the four sons of Iôn, from whom the Ionians, including those of Attica, were said to have descended. The division of the people into Eupatridai, Geômoroi, and Dêmiourgoi by Theseus affected all tribes alike, each providing its complement of Nobles, Yeomen, and Labourers. The division of each tribe into three *phratriai* or fraternities, and that of each phratria into thirty *genê* is undoubtedly the type of the Roman three tribes and gentes. The total number of twelve phratriai is that of the Hebrew tribes also. Each genos bore the name of its presumed ancestor, as with the Romans. Kleisthenês redivided the whole Athenian nation into ten new tribes (B.C. 510), and these, afterwards raised to twelve in number, lasted till the fall of Greece.

The earliest form in which men assembled as a community with mutual interests and close domestic, social, and political relations, was undoubtedly the tribe. It has generally been supposed that it originated in a single family, whose descendants would naturally be bound together by a variety of circumstances. This family, in the course of time, would ally itself either by marriage or for defensive purposes with other families, or, if strong enough, would employ force to compel them into union.

TRIBU'NAL OF FIRST INSTANCE. See DEPARTMENT.

TRIBU'NALS OF COMMERCE are courts established in most of the large towns of France for the quick and inexpensive decision of commercial disputes and all matters relating to trade and debts. The presidents and judges are chosen from among the most intelligent and respectable merchants of their respective towns, and serve without emolument. A president and two judges form a court, which sits every day except Sunday. The clerks are the only officers who are paid. The decisions of these tribunals are admitted to be highly satisfactory and equitable.

TRIB'UNE, according to the etymology of the word, signifies any officer who is at the head of a tribe (*tribus*), and conducts either its internal administration, or represents it in its relations to other powers in the state. This signification applies indeed to some of the many officers of this name who occur in the history of Rome, but in regard to others it cannot be accepted.

The Tribuni Plebis were the most important, and whenever tribunes are mentioned without any further qualification these alone are meant. In the year B.C. 494, when the plebeians had been driven by the oppression of the patricians to secede to the Mons Sacer, peace was concluded between the two orders on condition that the plebeians should be allowed magistrates of their own to protect them against the patrician magistrates, and their persons should be sacred and inviolable. It was further agreed that whoever should maltreat, kill, or compel a tribune to anything by force should be outlawed and his property forfeited to the temple of Ceres.

At first there were but two tribunes, but afterwards there were five—one to each class of citizens—and later still there were ten, two to each class. Plebeians only were eligible down to the close of the republic; but the office was one of such dignity that it was not uncommon for a patrician to renounce his order that he might as a plebeian stand for the tribunate.

The first idea of the tribunate was simply defensive, but the tribunes quickly had a sort of plebeian arbitratorship or magistracy thrust upon them. A tribune's door was bound to stand open day and night, and he had to lend aid to any plebeian (or to any citizen whatever) against oppression offered by one of the higher magistrates. His power ceased a mile outside the city gates, and he was forbidden to be absent from the city for a whole day at a time. The authority of the tribunes, at first confined to quarrels among the plebeians, soon extended. In B.C. 456 they convoked the senate, and in B.C. 452, having demanded certain legislation from the senate, they attended in the senate-house to watch the debates. A short suspension during the decemvirate was followed by increased power at the restoration of the tribunate. Tribunes were now made *ex officio* senators, occupying benches in a separate part of the house. They obtained the power of taking the auspices, and later on assumed that of citing patricians by impeachment before the tribes as a whole. In B.C. 449 a *plebiscitum* or law passed by the people assembled in tribes was made binding on the whole state. Finally a custom grew up that the veto of any one tribune should suffice to prevent any proposed resolution of his colleagues, even if they had the majority: and from this the tribunes passed

on to assume the right of veto over any bill whatever, whether originating from the senate or the tribes, or in any other manner. They even prevented the consul from convoking the senate, or compelled him to obey the senate, while at pleasure they vetoed a decree of the senate itself. They alone had the right to propose amendments to bills brought in the senate by the consuls. They had now become the most powerful officers in the state, and so remained till Sulla annulled the greater part of their privileges. Pompey the Great restored them, but they were soon swallowed up in the great centralized power of Julius Cæsar, and from this time, except in name, the tribunes disappeared, for the functions they still retained were merely administrative. In this form they still existed in the fifth century of our era.

In B.C. 23 Augustus received the office of tribune for life, and at intervals of five years he himself appointed one of his friends or relatives as his colleague in the tribunate. This *tribunitia potestas* of an emperor was conferred upon him by the senate, and was deemed equivalent to regal or dictatorial power with a popular name.

The Tribuni Militum cum Consulari Potestate were officers with consular authority, who were elected both from patricians and plebeians, whenever from various causes it seemed better to avoid the election of consuls. The first were elected in 444 B.C. In B.C. 366 the office was abolished, and the annual consulship permanently restored.

The Tribuni Militares or Militum (tribunes of the soldiers) were a class of officers in the Roman armies, of whom at first there were four in a legion. In later times the number was increased to six, and their appointment was sometimes left altogether to the consuls. But this seems to have been an exception to the rule, for subsequent to that time we again find that the people had the election of a part of the tribunes. Their functions consisted in maintaining discipline among the troops, superintending their exercises and their state of health, inspecting the sentinels, settling disputes among the soldiers, taking care that they received their necessary provisions, and the like.

TRIB'UTE, originally a war tax levied on all the burgesses of ancient Rome according to the division of their tribes (*tribus*), and collected by the tribunes, whence its name. Its first amount was 1 per 1000 ases of the gross income; and it grew to 3 per 1000 in Cato's time. After the Macedonian War, B.C. 147, Roman citizens were exempted from tribute, and this was levied upon conquered towns and countries, from this time the great source of Roman revenue. But in 43 B.C. an exhausted treasury compelled resort to the old Roman tribute again. It was afterwards imposed from time to time as needed by the emperors. Provincial tributes, however, so far outweighed the older form of the tax that the term now conveys, unless explained, the tax paid by a conquered country to its conquerors.

TRICHI'NA, a genus of NEMATODA or Threadworms, containing a dangerous human parasite, *Trichina spiralis*. This parasite was first observed in human muscles in 1835 by Sir James Paget, the distinguished surgeon, then a student at Guy's Hospital; and was subsequently described by Sir Richard Owen in a paper communicated to the Zoological Society. In 1860 Leuckart succeeded in tracing the development and life-history of these muscle-Trichinæ, proving that they were the larval forms of a nematoid worm. In the same year Zenker showed that a formidable disease, now known as Trichinosis, was due to the presence of these parasites.

The *Trichina spiralis* is exceedingly minute. When full grown the male is not more than one-eighteenth of an inch in length; the female about one-eighth. The body is rounded and thread-shaped; the head is narrow and pointed, with a simple mouth in the centre. The body of the male ends in two hooks, between which lies the cloacal opening. The female is stouter than the male, rounded posteriorly, with the generative opening situated well forward. These sexual forms are found in the intestines of man and other Mammalia, the males being the rarest. In two or three days after their introduction into the alimentary canal they become sexually mature. The males soon die after having fertilized the females. The latter in about six days after fertilization produce a brood of viviparous embryos, minute hair-like worms, which migrate into the tissues of the host. Piercing the walls of the intestine, they make their way, partly by their own movements in the bundles of connective tissue, and partly carried by currents of blood, into the striped muscles of the body, which soon begin to degenerate in consequence of their presence. "The infested muscle," says Leuckart, "loses its true structure. The fibrillæ collapse into a finely granular substance, while the muscular corpuscles change into oval nucleated cells. The infected muscular bundle retains its original sheathing up to the time of the complete development of the young Trichinæ, but afterwards its sarcolemma thickens, and begins to shrivel at the extremities. The spot inhabited by the rolled-up parasites is converted into a spindle-shaped widening, and within this space, under the thickened sarcolemma, the formation of the well-known lemon-shaped or globular cysts commences by a peripheric hardening and calcification." These cysts, within which the Trichina is spirally coiled, can be detected by the naked eye, measuring one-eighteenth of an inch in length, and one-thirty-sixth of an inch in breadth. The muscle-Trichinæ can live in this encysted condition for years, further development being arrested until it is transferred into the alimentary canal of some warm-blooded animal in the flesh of its first host. In this case the cyst is dissolved by the action of the gastric juice, the Trichina quickly attains sexual maturity; and thus the life-cycle is completed.

The disease known as Trichinosis is the result of eating trichinous flesh, especially pork infested with these parasites, which are to be met with in smaller or larger numbers in almost all pigs. It is thus of the greatest importance to see that in every case pork be most thoroughly cooked, and that the meat be obtained from healthy animals. Wherever pork is eaten raw, or in the form of sausages which have not been sliced and thoroughly fried, Trichinosis is sure to prevail. Thus follows the periodic recurrence of this loathsome and often fatal disease in different parts of Germany, where chopped raw pork forms a favourite meal. The pig appears to obtain this parasite chiefly by feeding on the carcases of rats, and also from human fæces; the rat may obtain it from this last source, and as it devours its own species, it runs a double risk of being infected. The enormous number of Trichinæ which an animal may have within its muscles, was proved by an experiment made by Cobbold, who counted 80,000 in a single ounce of pig's flesh.

The dangerous nature of trichinosis is due to the migration of these hordes of trichina-embryos through the tissues of the body, causing pain, fever, paralysis, and often death. At the commencement of the disease attempts should be made to expel the mature worm from the intestines by purgatives, of which calomel is considered the most serviceable. It is suggestive to remember that the Mosaic sanitary arrangements appear to have had this disease in view, when the Israelites were prohibited the use of pork.

TRICHINOP'OLY or **TRICHINAPALLI**, a town of British India, capital of a district of the same name in Madras, on the right bank of the river Cavery, 190 miles S.S.W. of the city of Madras, with which it is connected by rail. The population is 30,000. The fort of Trichinopoly is built on a granite rock about 600 feet high. Outside the densely populated native town, which was formerly inclosed within the walls of the fortress, are extensive

barracks, hospitals, public rooms, a church and Roman Catholic chapel, and the tomb of Bishop Heber, who died here. The surrounding country is fertile and populous; and the island of Seringham, which is here formed by the Cavery, is famous for the size and wealth of the Hindu pagodas upon it. Trichinopoly is the southernmost station of British troops in India. Cotton cloths, hardware, harness, cheroots, indigo, and jewlry are manufactured and exported to different parts of India and Mauritius. Trichinopoly, after the death of its last rajah in 1782, fell under the sway of the Nawab of Arcot, and subsequently changed hands several times, figuring conspicuously in the contests of the French and English for supremacy in India. It finally came under English government with the rest of the Karnatic in 1801.

TRICHI'TES (Gr. *thrix*, a hair) are microscopical hair-like particles of crystalline mineral matter, met with on examining thin slices of igneous rocks. They are too small to allow of the determination of their composition.

TRICHIU'RUS. See HAIR-TAIL.

TRICHOP'TERA. See CADDIS-FLIES.

TRICHOSAN'THES, a genus of plants belonging to the order CUCURBITACEÆ, so named from the flowers being beautifully fringed. The species, which are chiefly natives of the warmer parts of Asia, are trailing or climbing plants, with heart-shaped leaves and monœcious flowers. Many are edible, and from the long, often sinuous-formed fruit, they have been named Snake Gourds. The principal edible species is the *Trichosanthes anguina*, a native of India and China. The fruit is from 1 to 3 feet long, and for its sake the plant is much cultivated in different parts of Asia, the fruit being universally used in the stews and curries of the natives of India.

The Serpent Cucumber or Viper Gourd (*Trichosanthes colubrina*), a native of Central America, has even longer fruits, attaining a length frequently of 6 feet or more. *Trichosanthes cucumerina* (the Doommaala) is a native of Southern India and Ceylon. It contains tannic acid, and is used in Ceylon by the native doctors as a remedy in fevers.

TRICLIN'IUM, the Roman dining-room, generally supplied with three couches surrounding a table, the fourth side being left open for the supply of viands. On each couch three guests reclined almost flat on the breast while eating, but leaning on the left elbow between the courses or after the meal. See Plates I., II.

TRI'COLOUR, a national flag divided into three parts, each of a distinctive colour.

The tricolour *par excellence* is that of France, made up of vertical divisions, the three colours used in the arms of the city of Paris, red, white, and blue—blue next the mast. These three colours were first combined by Mary Stuart, queen of Scots, when Dauphiness of France. The white was the royal colour of France, the blue was the royal colour of Scotland, and the red represented Switzerland, in honour of the Swiss Guards who were to wear the livery. The city of Paris coloured its arms after the royal admixture thus—a ship with white sails on a red ground, with a blue chef or upper band.

Other tricolours are that of Holland (granted to the provinces by Henri Quatre of France), which is red, white, and blue horizontally divided; that of Belgium, black, yellow, and red, vertical; and that of Italy green, white, and red, also vertical. Our own Union Jack carries the three colours, red, white, and blue, but as they are not in separate divisions it is not reckoned as a tricolour.

TRI'CYCLE, BI'CYCLE, and other forms of **CYCLE,** which were formerly included under the name of *Velocipede*, have a comparatively recent origin. The Parisians claim the honour of the invention. The *Journal de Paris* of 27th July, 1779, describes a vehicle projected by M. Blanchard, the aeronaut. This, like several machines which followed it, had four wheels and required the active effort of two persons, one seated in front with ropes to direct, another behind who supplied the motive power by pressing his feet alternately on the ground. The latter rider must have had a melancholy time of it. A generation later the *Célérifère* made its appearance at Paris, but this was merely a variation of the old hobby-horse. It is interesting to remember that Nicephore Niepce, to whom is attributed the invention of photography, was certainly one of the first who succeeded in making a passable velocipede which was propelled by the action of the feet on the ground, in the same manner as the dandy-horse. This was in the year 1818, and it is in this year that we have an impetus given to the construction of primitive-looking cycles, such as are illustrated in Plate I., figs. 1 and 2. A reference to the old French patent lists shows that on the 17th of February, 1818, one Louis Joseph Dineur of Paris, acting for Baron von Drais of Mannheim, secured a patent for five years for a *machine dite vélocipède*. This machine was patented in England in December, 1818. It is thus described in a contemporary newspaper:—"The principle of this invention is taken from the art of skating, and consists in the simple idea of a seat upon two wheels, propelled by the feet acting upon the ground. The riding-seat, or saddle, is fixed on a perch upon two double-shod wheels running after each other, so that they can go upon the footways. To preserve the balance, a small board, covered and stuffed, is placed before, on which the arms are laid, and in front of which is a little guiding-pole, which is held in the hand to direct the route. The swiftness with which a person well-practised can travel is almost beyond belief." Such is the origin of the dandy-horse (fig. 3), called for a time *Draisena* in Paris and *Drais Laufmashin* in Germany. It was followed in the same year by several improvements, one by a working cutler of Leeds, named John Baynes, whose idea involved removing the feet from the ground and substituting a series of crutches, which were moved by treadles and levers. A much better contrivance was the improvement of Lewis Gompertz (fig. 4). He seized the idea of aiding the legs of the rider by applying power direct to the driving-wheel, by means of a toothed rack acting in a pinion fixed to the axle of the front wheel. The handle is moved backwards and forwards by the hands and arms of the rider, and thus brings the toothed segmented rack against the pinion. It must be admitted that Gompertz's invention was a great stride in advance of the dandy-horse. That peculiar machine had for a time a great vogue. When distributing the prizes at the Crystal Palace in connection with cycle races in 1877, Mr. Robert Lowe (now Lord Sherbrooke) claimed to have ridden a dandy-horse in the reign of George IV. The exercise could not have been at all graceful, and those who indulged in it were unmercifully laughed at, the wits describing them as riding in their own carriages and walking in the mud at the same time. The large number of caricatures in the British Museum indicate the extent to which dandy-horse riding must have been adopted. One such sketch shows the blacksmiths of a village pursuing the riders, upsetting them and smashing their machines to pieces, and this because the dandy-horse never required shoeing. A variety of crude attempts at improvement went on for some years, of which one of the simplest is the Dublin Velocipede, shown in fig. 5, which had four wheels, and of which the frame was made of iron, the treadles of ash, the wheels of elm, and the spokes of hickory.

It was not until two or three years prior to the great exhibition of 1862 that any real advance was made towards the production of the bicycle of to-day. It is thought that a crank working velocipede had been constructed by Gavin Dalzell, a cooper of Lesmahagow, Lanarkshire, as early as 1836; but so far as public ad-

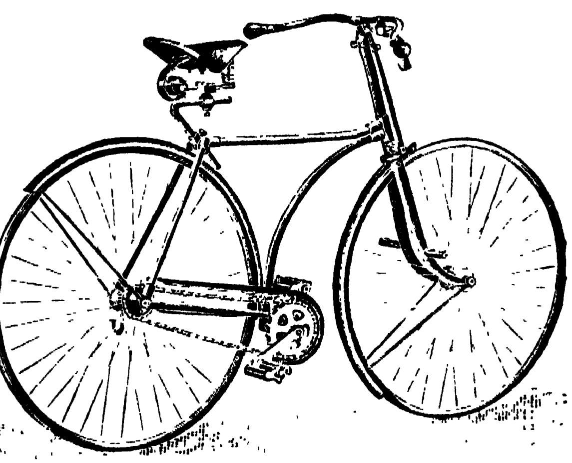
vertisement is concerned, the credit of first applying the crank action belongs to Messrs. Mehew of Chelsea, who showed a three-wheeled velocipede in the exhibition of 1862. Like many other useful discoveries, the real inventor of the modern bicycle is open to question, and nothing certain can be stated. Its earliest form is shown in Plate I., fig. 4, and the more famous and still not quite obsolete "bone shaker" in fig. 6. The frames were of heavy solid square iron rods, in many cases coiled and curved in a clumsy attempt to break the jar of the roads; the wheels generally of hickory wood, with a heavy hub, faced with a brass plate, and tired with iron, of course rattling tremendously over stones. The head was a long and heavy socket turning on a curved shoulder, which was unpleasantly liable to fly right round, and either strike a heavy body blow or catch the leg between the tire and the backbone. At the top of the head was an elaborate bracket, bearing a 16-inch handle bar, about on a line with the rider's chest. The whole fabric was absurdly heavy, and when it had seen some service became loose in every joint. Even with such machines as these it was possible to obtain a great deal of pleasure and excitement, and some races which took place at the Crystal Palace in 1869, and at the Agricultural Hall, Islington, in 1870, attracted much attention. From these dates cycle races have taken an acknowledged place in the programmes of athletic sports, and it cannot be doubted that many improvements in the manufacture of bicycles and tricycles are due to the competition on the racing path. With such competition we have here nothing to do. Feats ever more and more remarkable are recorded from day to day in the newspapers, and with the constant improvement of machines it is impossible to see any limit to the extraordinary performances of the racing man. It is rather for the cyclist with whom wheeling is a matter of health or recreation that we write.

The circumstance which led to the general introduction of cycling among the community, until at last it is computed that we have 500,000 riders in Great Britain alone, was the invention of the suspension wheel by Edward Cooper. "Before the invention of the suspension system," says Viscount Bury, "wheels were made of light and strong hickory or other wood, like the wheels of the ordinary carriages intended to be drawn by horses, which are still in use on the roads. In wooden wheels the weight of the whole carriage rests on the particular spoke which happens to point perpendicularly downwards, and the stability of the wheel depends on the rigidity of that particular spoke. Exactly the reverse of this occurs in the case of the suspension wheel; in it the weight of the rider and carriage rests on the centre of the wheel, and is suspended from that part of the felloe which happens to be uppermost, by means of the spoke then most perpendicular. The weight is thus constantly shifted from spoke to spoke as the wheel revolves, and the lateral spokes, being all laced tight, prevent the wheel from buckling or getting out of shape. The result of this most ingenious arrangement is that comparatively fine steel wire is substituted for a stiff wooden spoke, and the cycle wheel presents the beautiful and graceful though apparently fragile appearance which every-one no doubt has admired."

The ordinary bicycle was improved year by year until it reached such developments as the "King of 'Clubs'" (Plate II., fig. 10), which is an admirable type of a machine still very much in use. The worst of such machines, or the best of them to those who prefer the element of risk in all their amusements, is their liability to accident. And it was this which led a gentleman named Otto to think of the possibility of riding upon two wheels in such a position as to avoid the risk incurred by the seat being placed above a high wheel, and he invented the "Otto" type, or Dicycle, of which the latest development, Welch's Patent (fig. 7), has none of the disadvantages in going down hill or turning corners which pertained to earlier makes, but has not come prominently before the public, in consequence of uncertainties as to patent laws.

On the other hand, the monocycle, unicycle, or one-wheeled velocipede, although constructed in many forms, has never yet been made in a way to command popular favour, and is now only to be seen in cycling entertainments. In one invented in 1870 the rider sat inside the wheel; in another he sat on the top of it.

Greater interest pertains to the attempts to secure safety by lessening the size of the bicycle. The so-called Safety Bicycle is not necessarily much safer than its taller companion; that is to say, an immunity from "headers" or falls over the handle-bar is not secured, but the smallness of the wheels reduces the height which a rider has to fall. It is appropriate to describe such machines as the Facile and the Kangaroo as "dwarfs." Of these, the Facile, which is driven by a lever, was the first satisfactory Safety. The Xtraordinary, although of larger build, is really much safer; but the most notable success in the older type of Safety bicycles is the Kangaroo of Messrs. Hillman, Herbert, & Cooper, of Coventry. It attracted a great deal of attention at the Stanley Show in 1883; and during the years 1884–86 it was extremely popular. Like most of the chain-driven Safeties it had a geared-up, big steering and driving wheel in front, and a relatively small hind wheel. Its faults are excessive vibration and a great tendency to wobble. The years 1886–87 saw a complete change in fashion as regards Safety bicycles, by the general adoption by all makers of the Rover type of machine. The Rover Safety (Plate II., fig. 8), introduced by its makers, Messrs. Starley & Sutton, of Coventry, in the year 1885, although perhaps not equal in the racecourse with the older forms of bicycle (fig. 10), will hold its own on the



The Apollo Safety, of the Rover type.

road with any of them, and thoroughly deserves the name of "Safety." The machine is also free from vibration, and, unlike the Kangaroo type, has only one chain. The most notable machines of the Rover class are the Premier Safety, the Apollo Safety, the Psycho, and the Swift; but all the good makers look upon this pattern as one of their most important items. We annex a sketch of the Apollo, which is a good example of the Rover type.

It was not until 1878 that the tricycle was first advertised as a practical vehicle, but for many years after this

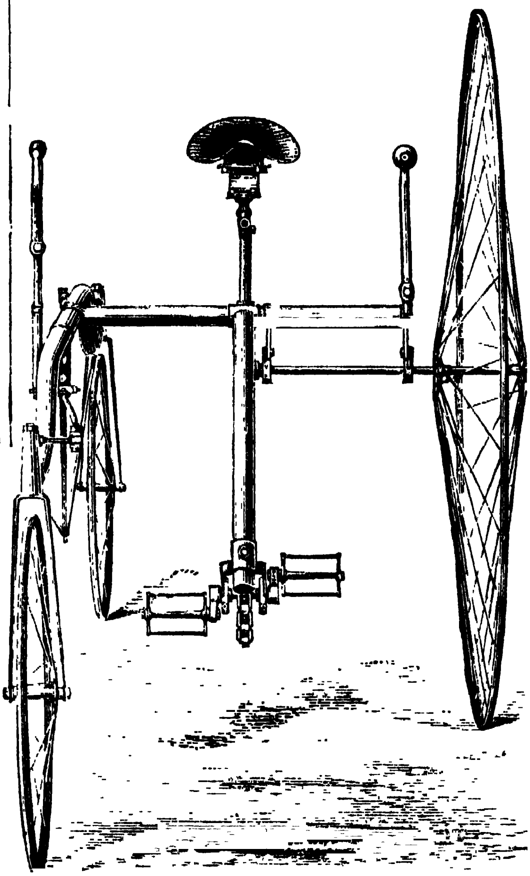
it passed along the public roads amid the contemptuous sneers of the loftily-mounted bicyclist, who despised such effeminate indulgences. Now all this is changed, and many bicyclists have taken to tricycles, or at least to Safety bicycles. The relative merits of bicycles and tricycles are scarcely worthy of discussion. For young and active riders it must be entirely a matter of taste. For ladies, who have recently recruited the ranks of cyclists in very large numbers, the bicycle is impossible. Stout and elderly persons usually lack the activity required for quickly dismounting, and had better use the tricycle, which permits the rider to stop at will. The bicycle has certainly the advantage as regards facilities for stowage. It would be impossible to give any idea within the limits of this article of the innumerable machines which for many years have annually been placed upon the market. To the intending purchaser we would say that Griffin's little handbook, "Bicycles and Tricycles of the Year," which is published annually, is a very fair and apparently disinterested critical summary. In going to one of the best makers, the Coventry Machinists Company, the Humber Company, Singer & Company, Dan Albone, the Quadrant Tricycle Company, the Sparkbrook Company, Rudge & Company, Starley Brothers, and Hillman, Herbert, & Cooper, one is certain to be safe; although many less known makers are liable at any moment to surpass these, and there are few better machines in the year 1887 than the Eureka tricycle of Messrs. Bayliss & Thomas. Any references in this connection can be but of tentative value, as great changes are made every year, and, indeed, the enthusiastic and well-to-do cyclist changes his machine continually on that account. The only important advice to be given on this point is that the country cyclist should on no account be tempted by low-priced articles which do not bear a maker's name. Once accustomed to his machine, a rider becomes firmly persuaded that it surpasses all other makes in the market; and this may perhaps be taken as a proof that the differences are not very great, and that a Quadrant, a Humber, and a Marlboro' Club are alike beautifully and thoroughly made. Tricycles of recent date may be roughly classified as:—Humber Type, Spade-handle Front-steering, Quadrant, Coventry Rotary, Cripper and Direct-steering, Sociables, Tandems, Velociman Manumotors, and Carriers.

Humber type tricycles (Plate II. fig. 11) were first made by Messrs. Humber & Co. With so many of the characteristics of the bicycle they soon became popular, and are now recognized as among the fastest machines upon the road.

Spade-handle Front-steering tricycles (Plate II. fig. 9) have somewhat lost caste among male cyclists during the past year or two, but they are of inestimable advantage for lady riders, as they afford greater facilities for dismounting than the Cripper type. By grasping the spade-handles one is also much more likely to expand the chest than by using a bar in front, as is done with the bicycle steering machines now most in vogue. At any rate the front-steering spade-handle machine very speedily superseded the rear-steering type, of which the Cheylesmore may be considered a popular example. Of the highest value for hill-climbing and for ploughing through rough roads, it was speedily discovered that for descending hills the rear steerer (*i.e.* small wheel behind) was extremely dangerous.

The *Quadrant* type of tricycle came suddenly into well-deserved popularity, and it was in this type that the very sound principle of a large front steering wheel was first adopted. It resembles the Cripper and Strait-steering tricycles (Plat II. fig. 12) in its large front wheel, and is made with both spade and bicycle handles. One of these latter patterns (Ladies Quadrant of 1887) is especially adapted for ladies by the handles hanging in the centre, so that they can be turned forward to allow of an easy dismount in front.

The *Coventry Rotary* tricycle is a very old type, which differs materially in design from nearly every other make, having, as the accompanying illustration shows, a large driving wheel on one side and two steering wheels on the other. In consequence of its long bar it has perhaps the

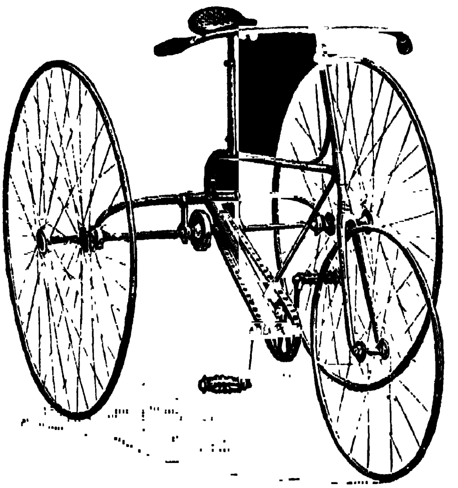


The Coventry Rotary type.

most satisfactory carrying capacity of any machine yet made. Sticks, guns, and fishing-rods may be strapped on with the greatest ease, and we should say that this was pre-eminently the machine for the artist. Being only about 30 inches wide it also readily lends itself to the exigencies of narrow doorways, a sore point to many town tricyclists, telescopic machines, as the present writer has found to his sorrow, not being altogether satisfactory.

Cripper and Direct-steering tricycles have during the years 1886-87 almost banished other patterns from the road. It may be said that the Cripper type was in fashion in 1886, and the direct-steering type in 1887. The title of Cripper was given to the type because it was first used upon the racing path by Mr. Robert Cripps. The steering is effected in all these machines by means of a bicycle handle communicating direct with the front steering wheel, and the machine is mounted from behind. It would thus seem unsuitable for ladies, who are now much catered for by the manufacturers; but several machines have a jointed handle-bar, which lifts up and renders a mount from the front practicable, although scarcely as comfortable as with older patterns. The Cripper type has automatic or controlled steering, by which the front wheel flies back into

position when turned from the straight, and usually a small front wheel. The direct-steering tricycle, of which Singer's Straight Steerer, or S.S.S., is an admirable example [see Plate II., fig. 12], has its handle-bar quite uncontrolled by springs, and has a 28-inch pilot or front wheel. Every good maker has produced one or more of these machines, and the S.S.S., the Marlboro' Club, the Humber, the Premier, and the Psycho are so thoroughly well made that



The Direct-steering type.

it would be invidious to pronounce on their respective merits; but, indeed, so rapid is the progress of invention in the cycling world that a few years may see all these machines fall into desuetude.

Sociables are double tricycles in which the riders sit side by side. They have, in a large measure, been superseded by *Tandems*, in which the riders sit one behind the other. *Velociman Manumotors* are tricycles propelled by the hands, and they are of much value to those who have lost the use of the lower limbs. The inventor of Singer's Velociman (Rev. Mr. Charsley of Oxford) has ridden from London to Oxford, a very hilly ride, without dismounting, and has also travelled 100 miles in a day. A rural postman, to whom one of these machines was presented after he had lost a leg, has been able to continue his occupation, and boasts that he has ridden 6 miles in thirty-five minutes.

Carrier Tricycles have been extensively adopted by the Post Office for the parcels post, by the *Standard* and other newspaper proprietors for the delivery of their journals, and by a number of commercial firms.

It may be well in an article on the tricycle to refer to the Cyclometer or Odometer, a little machine for recording distances in cycling. Attached to the axle or hub, it is a never-failing source of satisfaction to the rider who desires to be certain of his day's achievement. Of such inventions, by far the most remarkable is Boys and Rucker's patent, the Signal Cyclometer, in which a gong sounds at the completion of every mile.

Our space will not permit us to discuss the mechanism of bicycles and tricycles, and such knowledge is best acquired practically. It remains but to insist upon their value as a means of health-giving recreation, which may also be combined with a vast increase of knowledge, both in physical and social science. For very deaf persons and for persons suffering severely from heart-disease, the exercise is undesirable, but in the opinion of Dr. Richardson it is distinctly beneficial for the majority of men and women, and the statement that diseases are engendered by it may be dismissed as for the most part unverified. Dr. F. Campbell, the principal of the Normal College for the Blind at Sydenham, who is himself quite blind, travelled through Norway with his son on a tandem in 1886. It is to be regretted that the sport is so often vulgarized by the bad manners and lack of consideration shown by many votaries of the wheel, but it is in the power of every fresh recruit to the ranks of cycling to give tone and dignity to the exercise. Racing on the highroad, not drawing on one side on the approach of a restive horse, and such apparently trivial and thoughtless acts, have done much to bring cycling into disrepute with the non-cycling community.

The two most powerful organizations in connection with cycling are the National Cyclists' Union or N.C.U., and the Cyclists' Touring Club or C.T.C. The N.C.U. attends to the legal defence and legislation of cycling, and organizes race meetings. The C.T.C. attends to the wants of individual cyclists, by making arrangements with hotel proprietors for a lower tariff than that of the general public, and has adopted a distinctive dress and badge for its members, who number more than 20,000. It boasts the possession of a very creditable journal called the *Monthly Gazette*. The literature of cycling is very abundant. The best-known weekly journals in the United Kingdom are the *Cyclist* and *Wheeling*, but the Continent and the colonies have also a considerable press. Sturmey's "Indispensable Handbook" is an annual publication containing useful information. See also "Cycling," by Viscount Bury and G. Lacy Hillier (1887), in the "Badmington Library." Dr. Richardson's "The Tricycle in relation to Health" (1885), "Around the World on a Bicycle," by Thomas Stevens (1887), and "Ten Thousand Miles on a Bicycle," by Karl Kron (1887).

TRIDAC'NA. See CLAM.

TRI'DECYL, or **HYDRIDE OF COCINYL,** is a hydrocarbon found in American petroleum. It belongs to the marsh-gas series, and has the formula $C_{13}H_{28}$. It burns with a smoky flame, and has the odour of turpentine. It boils at 217° C. (422° Fahr.)

TRI'DENT (Lat. *tridens*) is an instrument of the form of a fork, with three prongs. In mythology it is the attribute of several marine divinities, such as Nereus and the Tritons, but above all of Neptune (Poseidôn). In these cases it is the same as the sceptre with other gods, the emblem of the power of these rulers over the waters.

TRI'DYMITE, a crystallized form of pure silica, occurring in small six-sided tables, belonging to the rhombic system. It is found generally in cavities in TRACHYTE, and sometimes, of microscopic dimensions, inclosed in quartz and opal.

TRIEN'NIAL ACTS. The first of these was passed in 1641 by the Long Parliament, and provided that a Parliament should be *ipso facto* dissolved three years from its first day of session; and further, that if the king neglected to call another Parliament for three years, a new Parliament should be elected in a manner carefully set forth, and this Parliament was not to be prorogued for at least fifty days, save by its own consent. This Act, broken by the Long Parliament itself, was repealed in 1664.

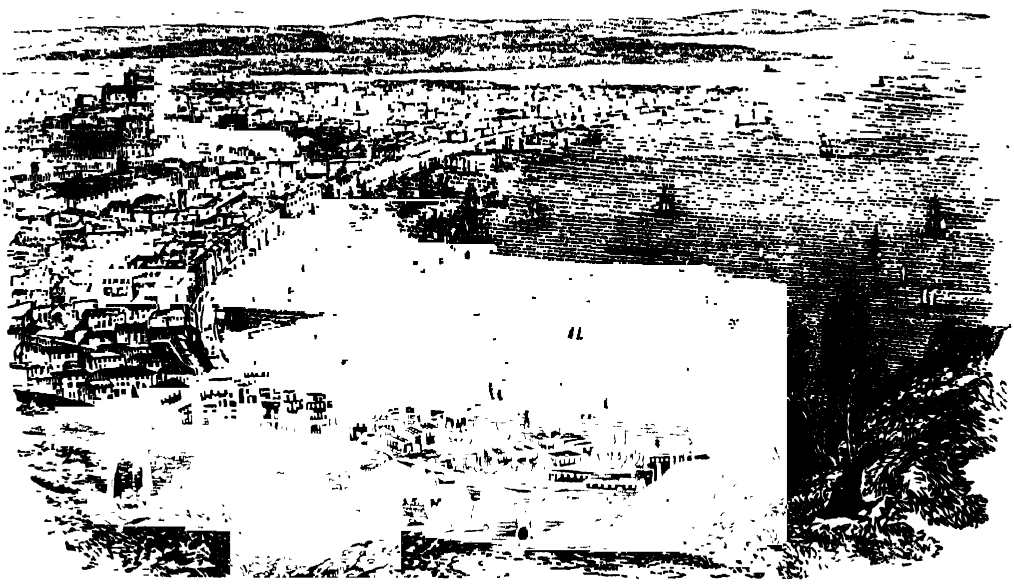
The second Triennial Act passed in 1694, and limited the duration of Parliament to three years; a term extended to the present one of seven years by the Septennial Act of 1716. O'Connell in 1830 made a sturdy fight for a return to triennial parliaments, but was defeated.

TRI'ENS, the third part of the Roman monetary unit, the As.

TRIER (Fr. *Trèves*), the capital of the district of Trier, in Germany, is situated 60 miles S.W. of Coblentz, on the right bank of the Moselle, over which there is a stone bridge of eight arches, 690 feet long and 24 feet wide, and with piers of the Roman period, consisting of enormous

blocks of lava. The town lies in a valley of extraordinary fertility, bounded by low hills covered with vines, and is undoubtedly one of the oldest cities in Germany. When Julius Cæsar was in Gaul the Treviri were a powerful people; their chief city was afterwards called Augusta Trevirorum. In later times this town was the residence of several emperors. It was nearly annihilated by the barbarians, yet subsequently almost recovered its ancient splendour under its archbishops. It was taken by the Duke of Marlborough in 1704, and during the wars of the eighteenth century suffered greatly, being re-captured by the French five times. It was then the capital of the department of Sarre. It was annexed to Prussia in 1815. The population in 1880 was 24,200. The manufactures consist of woollen and linen cloth, worsted, carpets, hats, porcelain, soap, glue, leather, tobacco, and refined wax. Boats for the navigation of the Rhine and the Moselle are built here. Trier is the seat of a bishop and a chapter, and of several tribunals and public offices. The university, founded in 1454, was suppressed in 1794, and is now called a gymnasium; it has a library of abov 10,000 volumes and 2000 MSS. There is a museum full of valuable antiquities, a college for the education of Catholic clergymen, several hospitals and schools, and a theatre. The ancient electoral palace, now converted into barracks, stands partly on the site of an immense Roman edifice, the walls of a fragment of which still remaining are 90 feet high and 10 feet thick. The Cathedral of St. Peter and St. Helena, in the earliest Byzantine style, is remarkable for its famous relics, among other the holy coat, the exhibition of which at various times has brought immense sums into the treasury of the citadel. The Liebfrauenkirche ("Church of Our Lady"), built between 1227 and 1248, adjoins the cathedral. The ancient abbey of St. Martin, a noble edifice, is now used as a porcelain manufactory. At one extremity of the open space in front of the electoral palace are the ruins of the Roman Baths, formerly called the White Gate. Among other Roman remains are the amphitheatre, portions of an aqueduct, the bridge over the Moselle, and the Porta Nigra, or Black Gate, one of the most remarkable Roman monuments in the north of Europe. It was probably built in the time of Constantine the Great. The interior at present contains a great number of Roman antiquities found at Trier and in the neighbourhood. Some of the sculptures have great merit. St. Ambrose, one of the fathers of the church, was born at Trier, and St. Jerome studied there.

TRI'ERARCHY, the company bound by law to maintain a trireme or warship in ancient Athens. A rich person originally served as trierarch by himself, but after B.C. 412 two persons were allowed to join in a trierarchy. The state provided the ship and her rigging and crew; the trierarch had to keep all in efficient repair and readiness, often at considerable expense. The usual charges reached about £200 a year of our money, and a trierarch was exempted from other state burdens in consequence. Later on the trierarchy fell into a sort of property tax, several persons being assessed according to their property to make up one trierarchy together. Usually sixty persons were joined together to find four triremes between them. The great Demosthenes extended the system still more, so as to include the whole available body of citizens in the assessment.



Trieste.

TRIESTE, the Roman *Tergeste*, a flourishing commercial city and seaport of Austria, in the province of Illyria, is situated at the north-eastern extremity of the Adriatic, about 70 miles east by north from Venice. The population in 1880 was 71,541, or if the surrounding territory belonging to the town is included the population is 145,000. It consists of two parts: the old city, standing on a hill with a castle on the summit, and the new town called Theresienstadt, which is built on level ground extending to the seaside. The old town has narrow, crooked,

dirty streets, especially in the Jews' quarter. The new portion, however, forms a regular square, with broad streets crossing each other at right angles, and some canals, one of which, called the Great Canal, presents a very animated appearance. Between the two parts of the city winds the Corso, a spacious thoroughfare, opening successively into several handsome squares, the principal of which is the Piazza Grande, containing a fine public fountain, the chief hotel, and the column and the statue of the Emperor Charles VI., to whom Trieste owes its modern importance. The principal public buildings are the exchange, the finest edifice in the town, situated in the above square, and adorned with a Doric colonnade, besides a spacious portal leading to a noble merchants' hall, while the storey immediately above is employed as a casino; the Duomo or cathedral, of great antiquity, in the Byzantine style, somewhat resembling St. Mark's at Venice, and surmounted by a tower which is said to stand on a temple of Jupiter; the church of St. Peter; the Jesuit church, with a fine Corinthian colonnade; two Greek churches, the Protestant churches, English chapel, synagogue, town-hall, custom-house, post-office, and three theatres. Outside the town, on the sea-shore, is the lazaretto, one of the largest and best arranged in Europe.

The harbour is of easy access. There is good railway communication with Vienna and other parts of Austria, and every convenience for shipping of goods from the interior of the country.

Trieste was for many years the great emporium for the trade of the Austrian Empire by the Adriatic. It is a depot for warehousing goods from the Black Sea, Turkey, and Egypt. The trade began rapidly to increase about the middle of the last century, when the Empress Maria Theresa made great improvements in the harbour, and constructed the Maria Theresa Canal. It was declared a free port in 1719, and its prosperity has still further increased since the opening of the Suez Canal. The principal exports are corn, rice, wine, oil, wax, flax, hemp, tobacco, silk, wood, hides, iron, lead, quicksilver, copper, alum, vitriol, silk stuffs, printed cottons, coarse and fine linen, soap, leather, glass, and liqueurs. The principal imports are colonial produce, raw and spun cotton, cotton goods, dried fruits, hides, salt fish, camel's hair, &c. Trieste possesses a large mercantile navy, and is the head-quarters of the Austrian Lloyd's Steam-packet Company. It has a larger amount of shipping than any other port in the empire.

Trieste is a bishop's see, the seat of an imperial academy, a school of navigation, and numerous other schools and learned associations. It has many banking establishments, insurance offices, newspapers, &c., and is the residence of consuls of most commercial nations. Its manufactures are varied, and in some branches extensive. The principal articles are white-lead, wax candles, soap, rosoglio, spirits, playing cards, earthenware, and morocco leather. A great number of vessels are also built, and an active shipping trade is carried on in the bay. There are several dyeing houses, sugar refineries, potteries, distilleries, and rope-works.

Trieste has a summer climate remarkable for its great and abrupt changes. The ordinary heat is intense, owing to the reflection of the rays of the burning sun from the rocky adjacent hills, while there is a general want of shade, with the occasional visits of the sirocco, a hot and oppressive south-east wind. This alternates with the Bora wind from the north-east, so piercingly cold, sudden in its onset, and so powerful that vehicles and passengers are overturned by its gusts. It is an imperial free town, and attached and belonging to it is a territory, 46 square miles in extent, consisting of the slopes of the Triestiner Karst, which are adorned with beautiful country seats and gardens, and decline somewhat abruptly towards the Adriatic shore. Most of the population is massed in the town, the other places being only small villages. Trieste existed under the Romans, but never rose to much importance till about the middle of the last century. In the middle ages it was the capital of an independent republic. The French took it in 1797 and 1805.

TRI'ETHYL'AMINE. See ETHYLAMINE.

TRI'ETHYLPHOS'PHINE and **TRIMETHYL-PHOSPHINE.** See PHOSPHORUS.

END OF VOL. XIII.

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